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NORTH FORK SMITH RIVER DAM

MANUAL FOR OPERATION AND MAINTENANCE

**State Water Project Bureau
Water Resources Division
Department of Natural Resources and Conservation
48 North Last Chance Gulch
P.O. Box 201601
Helena, MT 59620-1601**

**Initial Publication June 1995
Updated July 2001**

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OVERVIEW

North Fork of Smith River Dam is located in Meagher County approximately nine miles northeast of the town of White Sulfur Springs (Figure 1). The impoundment is commonly referred to as Lake Sutherlin. The project contains the water of North Fork Smith River and its tributaries. Runoff is supplied by 71 square miles of drainage area (Figure 2). Figure 3 provides a general layout of the dam, spillway and outlet works. Figure 4 show the location of the monitoring wells and weirs.

The dam is owned by the Montana Department of Natural Resources and Conservation (DNRC) and is managed by the State Water Projects Bureau (SWPB) of the DNRC. The Smith River Water Users Association (herein called the “association”) operates and maintains the dam.

The earthfill dam was completed in 1936. The dam has a hydraulic height of 84 feet and a structural height of 91 feet. The crest width is 27 to 30 feet and the length is 1300 feet.

The outlet works consists of a 408 feet of reinforced concrete conduit which is horseshoe shaped 5 feet high and 5 feet wide. The manually operated upstream slide gate valve is used for inspection and emergency shutoff. The manually operated downstream butterfly valve is the operating valve for controlling releases from the reservoir. The maximum capacity of the outlet is 860 cubic feet per second (cfs).

The spillway is located on the right (north) abutment in basalt rock material. The spillway is composed of a very short, abrupt approach section, a concrete crest with wooden flashboards, a short concrete discharge section, and a rock lined return channel. Control is provided by wooden flashboards 28

inches high and 3 inches thick. The concrete spillway is 135 feet long with a crest width of 80 feet, and tapers from 80 feet at the crest to 40 feet at the downstream end. Below the concrete spillway channel, the spillway discharge flows in a rock channel for about 250 feet where it makes a left turn and drops off the bench to the North Fork of the Smith River. The spillway capacity is 5,530 cfs with the reservoir pool at the dam crest.

Although water from the reservoir is primarily used for irrigation purposes, other uses include recreation, flood water control, and sediment accumulation.

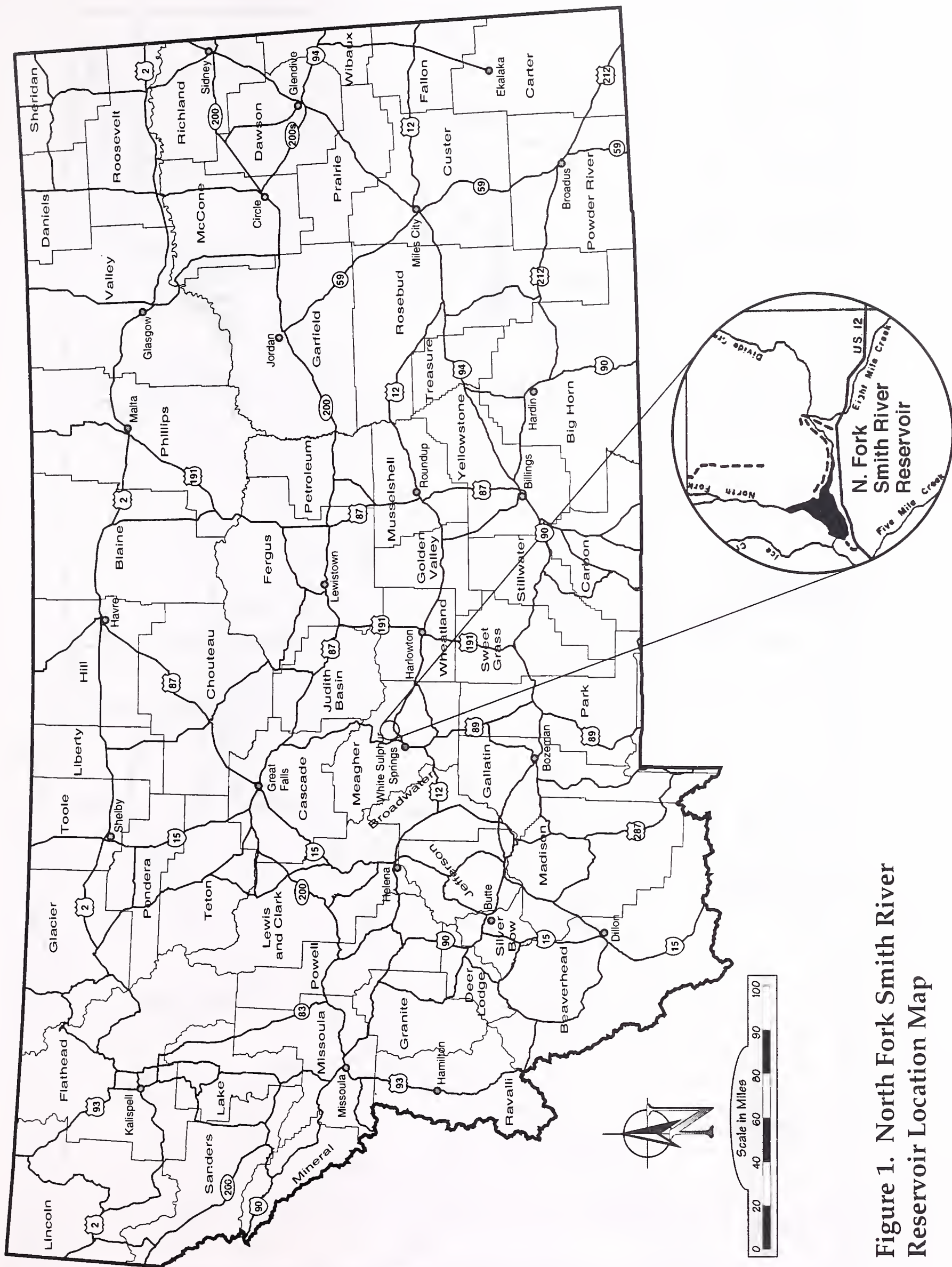


Figure 1. North Fork Smith River Reservoir Location Map

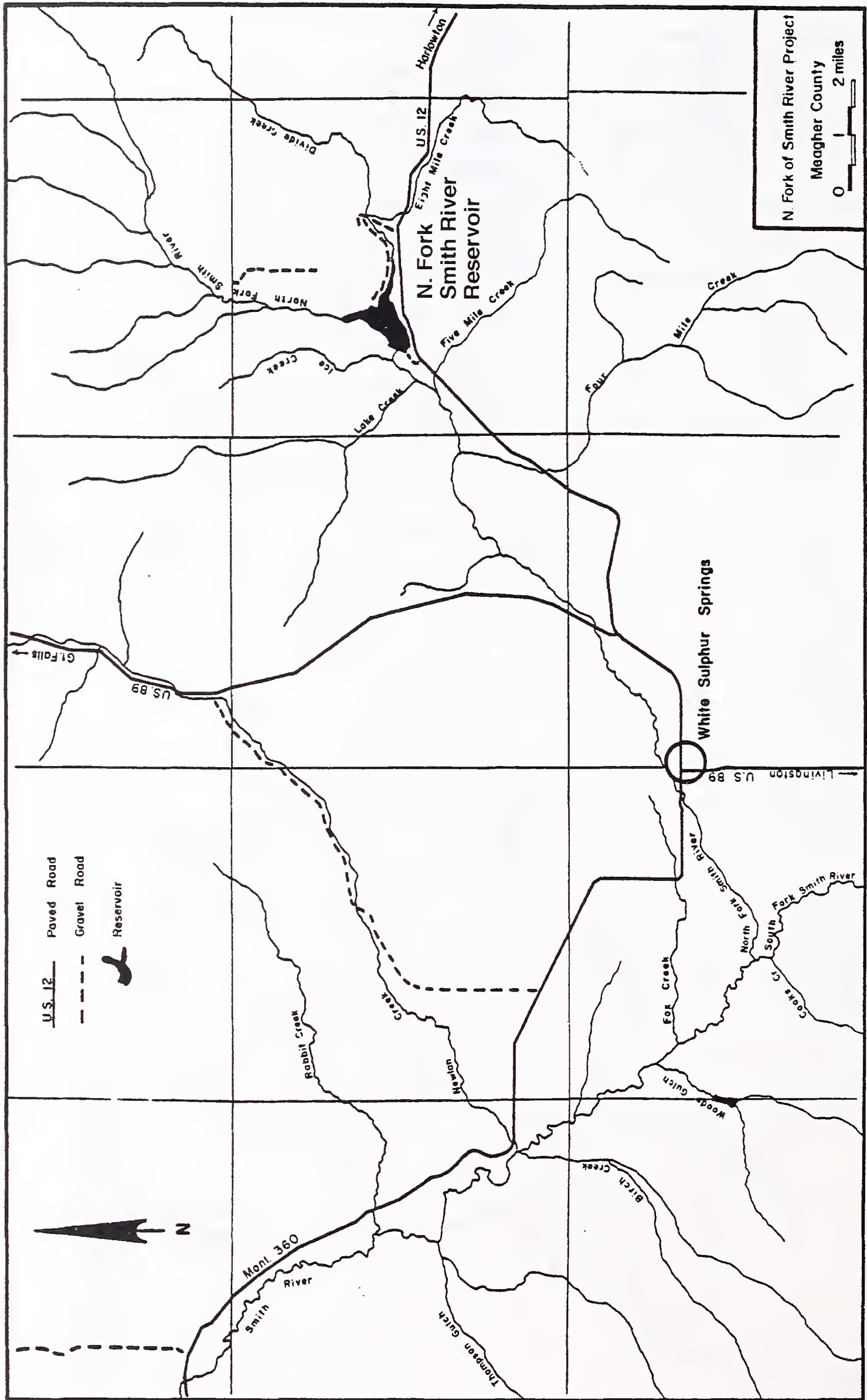


Figure 2. North Fork Smith River Project Map

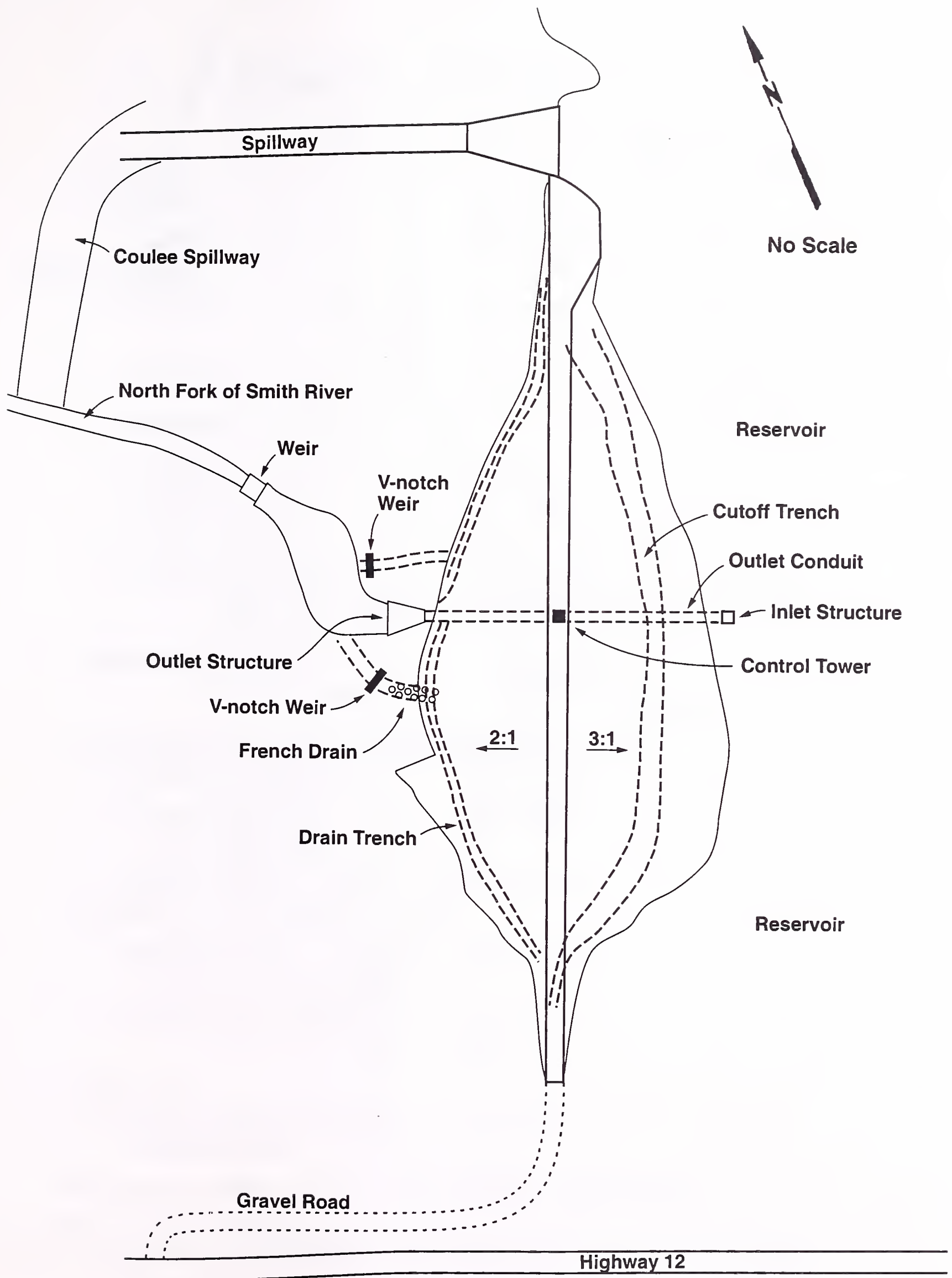


Figure 3. North Fork Smith River Dam General Layout

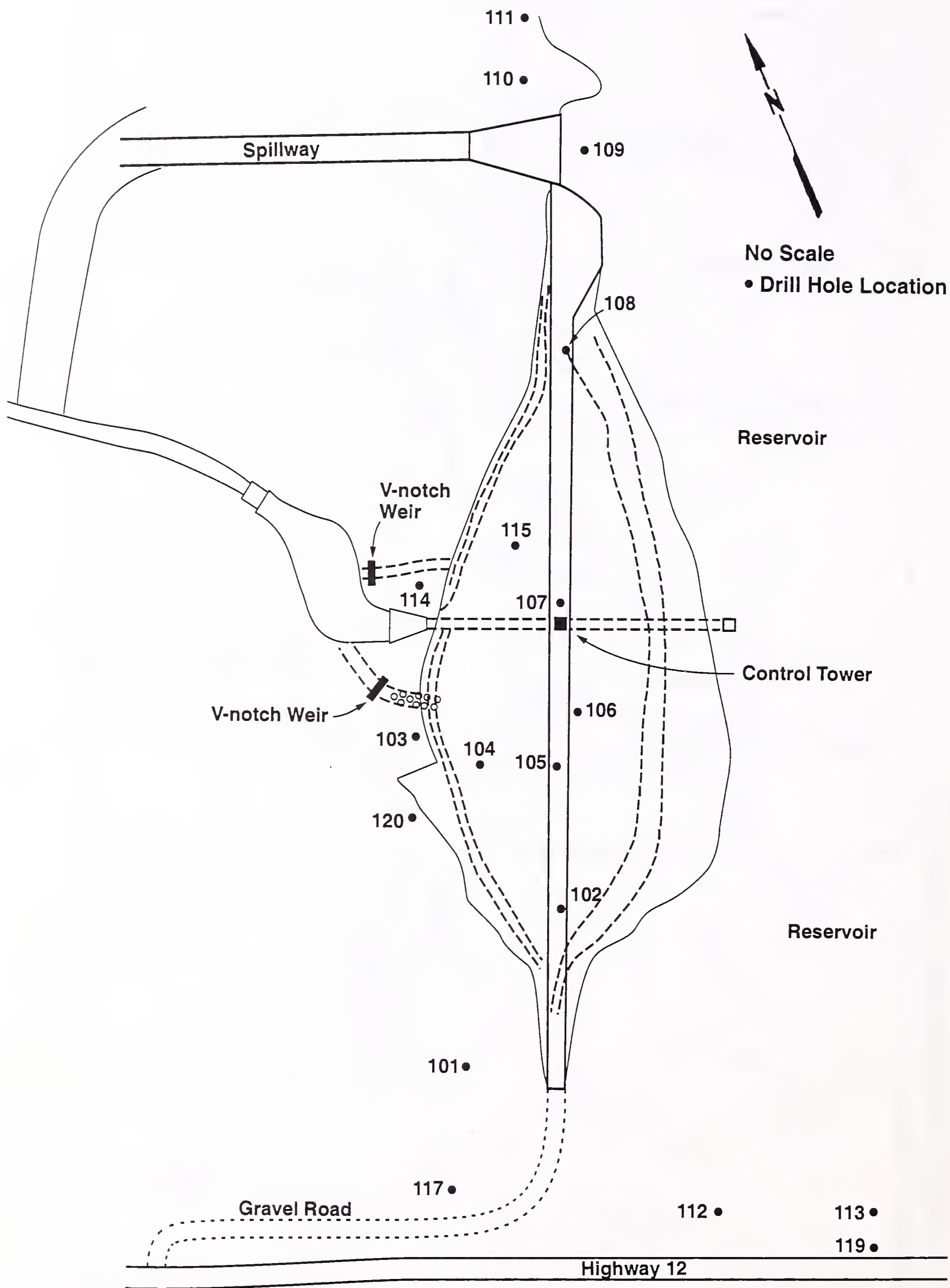


Figure 4. North Fork Smith Monitoring Wells Location

STATISTICAL INFORMATION

1. General

- | | |
|-----------------------|--|
| a. Owner | Montana Department of Natural Resources and Conservation (DNRC) |
| b. Operator | Smith River Water Users Association |
| c. Location | Sections 17 and 20, T10N, R8E, MPM, 9 miles northeast of White Sulfur Springs, Mt. |
| d. Latitude | 46.62° |
| Longitude | 110.75° |
| e. County--State | Meagher--Montana |
| f. Watershed Location | North Fork of the Smith River. Main watershed lies primarily northeast of the dam. |
| g. Drainage Area | 71 square miles |

2. Principal Elevations (feet above mean sea level)

- | | |
|--|-------------|
| a. Maximum Dam Crest | 5495.9 feet |
| b. Normal Full Pool
(with flashboards) | 5488.3 feet |
| c. Spillway Crest
(with flashboards) | 5488.3 feet |
| d. Spillway Crest
(without flashboards) | 5486.0 feet |
| e. Intake Invert (design) | 5413.5feet |

3. Reservoir

- | | |
|--|-------------------|
| a. Length of Maximum Pool
(approximate) | 2.2 miles |
| b. Maximum Reservoir
Level of Record | 5,489.44 (6-1-82) |
| c. Surface Area at
Normal Pool | 335 acres |

4. Storage

- | | |
|---|------------------|
| a. Total Storage
(pool at dam crest) | 14,200 acre-feet |
| b. Active Storage
(pool at flashboard crest) | 11,500 acre-feet |
| c. Maximum Surcharge
(from flashboard crest
to dam crest) | 2,700 acre-feet |

5. Hydrology

- | | |
|------------------------|--|
| a. Inflow Design Flood | Probable Maximum Flood
(PMF) (31,200 cfs peak flow) |
| b. 500-year Flood | 3,000 cfs |
| c. 100-year Flood | 2,100 cfs |

6. Embankment

- | | |
|---------------------|--|
| a. Type | Earthfill |
| b. Hydraulic Height | 84 feet |
| c. Crest Length | 1,300 feet |
| d. Crest Width | 27 to 30 feet |
| e. Upstream Slope | 1v on 2h at top, 1v on 3h at
bottom |
| f. Downstream Slope | 1v on 2h |

7. Spillway

- | | |
|---|---|
| a. Location | Right abutment |
| b. Type | Uncontrolled concrete ogee
crest with 28-inch high
wooden flashboards |
| c. Crest Width | 80 feet |
| d. Chute Width | 80 feet tapering to 40 feet |
| e. Chute Length | 135 feet |
| f. Capacity (with flashboards)
(pool at dam crest) | 5,530 cfs |

8. Outlet Works

- | | |
|--------------------------|--|
| a. Size | 5 feet high and 5 feet wide reinforced concrete, modified horseshoe shaped conduit. |
| b. Length | 408 feet |
| c. Control | Emergency gate -- manually operated 54-inch diameter slide gate
Operating gate -- manually operated 54-inch diameter butterfly valve. |
| d. Capacity: | |
| Pool at Flashboard Crest | 820 cfs |
| Pool at Dam Crest | 860 cfs |
| e. Trashrack | Assumed trashrack in place |

OPERATING PROCEDURES

The Smith River Water User's Association manages and operates the North Fork Smith River Dam and reservoir to insure safe operation of the project and provide an adequate supply of irrigation water to meet contracts with water users without exceeding safe storage or flow levels.

METHOD AND SCHEDULE OF OPERATION

A court decree dictates that the natural flow of the river be allowed to flow through the dam whenever decreed water right holders demand their water, primarily during the heat of the irrigation season. Consequently, most of the water stored in the dam is collected during spring thaw or when there is flow in the river in excess of water needed by the decreed water users.

Usually stored water isn't needed for early irrigation. Water is typically not released from storage until June 1st or later. However, in dry years releases may begin as early as May 15. Irrigation releases usually end by September 30, as specified in the water purchase contracts. The actual dates that releases begin and end vary depending on each year's actual climatological and hydrological conditions.

Most water users divert directly out of the river. The South Side Canal, a State financed delivery system, is the only organized multiple diversion project using water from Lake Sutherlin. This canal, which is operated by the association, is 12.5 miles long and has a capacity of 60 cfs. Two 30" diameter slide gates control flows into the canal and a water stage recorder is used to measure diversions.

With a water right decree in effect, a District Court appointed Water Commissioner is actually in control of releases from the dam. This Commissioner is not the same person who actually operates the dam. The Commissioner uses a weir upstream of the dam and another weir immediately downstream of the outlet structure to monitor inflows into the reservoir and outflows from the dam. For the Commissioner to effectively perform his/her duties, it is required that all diversions from the North Fork Smith River have water measuring devices in good working condition. The Commissioner's authority ends where the North Fork and the South Fork of the Smith River join in Section 21, Township 9 North, Range 6 East, Meagher County. This is because the South Fork Smith River is not an adjudicated stream.

Maximum Winter Storage: The maximum reservoir elevation for winter storage is 5,478.0 feet with 8,326 acre-feet of storage. This winter maximum helps prevent damage to the riprap and embankment from wind-driven waves.

Minimum Winter Storage: The minimum reservoir elevation for winter storage is 5,430.65 feet with 250 acre-feet of storage. This winter minimum helps prevent ice damage to the inlet structure for the outlet work.

Minimum Outlet Discharge: Fish, Wildlife and Parks (FW&P) recommends a minimum flow of 2 to 9 cfs be maintained at the dam outlet to help maintain the fishery in the North Fork Smith Creek.

SAFE DRAWDOWN

The stability of the North Fork of Smith River Dam has been investigated. As a result of this investigation, the recommended drawdown rate is one foot per day.

LIMITATION OF OUTLET WORKS

Appurtenances at dam consist of the outlet works and the spillway. With the reservoir pool at the dam crest, the outlet works capacity is 860 cfs and the design capacity of the spillway with the flashboards in place is 5,530 cfs. The combined maximum design conveyance capacity to North Fork of Smith River Dam is 6,390 cfs. A spillway rating table is shown in Appendix A.

The maximum gate opening for the low level outlet gate is 27 inches. Openings in excess of this amount may damage the gate, gate frame, gate stem or the gate pedestal. The 27 inches of operation is measured on the exposed portion of the gate stem between the top of the pedestal and the bottom of the stop nut.

DAM OPERATOR

Except for those daily releases controlled by the Water Commissioner from approximately May 1 to September 30, the responsibility for the operation of the dam and reservoir rests with the association and its dam operator. The dam operator is generally authorized to operate the reservoir to meet the association's goal of providing an adequate supply of irrigation water to the water user's contracts without exceeding safe storage and flow levels. Specific responsibilities of the dam operator are as follows:

1. Operate the mechanical features of the outlet works.
2. Coordinate filling of the reservoir and the release of water.
3. Notify the SWPB of any unusual occurrences such as vandalism, impending floods, structure failure, or excessive seepage.
4. Perform various maintenance tasks.
5. Monitor weather conditions.
- 6 Monitor seepage

Typically, the out-going dam operator, the association and the SWPB train a new dam operator. The dam operator's training focuses on the mechanical operation of the gates, storage level measurement, the rate of water release measurement, daily observation of unusual conditions and record keeping.

The outlet gates are normally operated with a hand crank. The outlet works are intended for controlling the release of irrigation water and not for providing emergency relief. The gates are also used to draw down the water level in the fall if the SWPB determines that the level is too high for safe winter and runoff season operation. Outlet releases during the non-irrigation season are usually dictated by river flows and freeze/thaw conditions.

The Water Commissioner is typically available to observe the dam and perform operating functions daily during the irrigation season. The dam operator usually checks the dam one of two times a day during heavy runoff periods. During the rest of the year, no set schedule is established for observation of the dam.

Communication among the Water Commissioner, dam operator, the association, and the SWPB typically takes place by telephone. Although not routinely available, radio communications may be established during emergencies or unusual occurrences so the dam operator can speak directly with county authorities and communicate indirectly with the SWPB staff (**see North Fork of the Smith River Dam Emergency Action Plan**).

STORAGE DETERMINATION

Storage in the reservoir and the elevation of the reservoir surface are determined by taking a slope measurement. Measure from the new 0+00 rebar pin located approximately 600 feet east of left dam abutment. The pin is 9 feet down from the highway fence. A white fiberglass post in the highway fence marks the location of

the new pin. Measure the distance from the new rebar pin to the water surface. The elevation of the reservoir surface and the storage can then be found using the Slope-Elevation-Storage-Table in Appendix A.

WEATHER MONITORING

The association and the dam operator monitors weather conditions through local weather forecasts and the National Weather Service (NWS).

If sever flooding is anticipated, the NWS Great Falls Office **(406-453-2081 or 406-453-4561)** should be contacted for information about the storm, such as the estimated storm intensity and duration, runoff duration (above base flow), and total flood volume of the storm in the North Fork Smith River drainage.

INTERACTION WITH OTHER DAMS

The only dams located between North Fork of the Smith River Dam and the mouth of the Smith River some 116.5 miles downstream are local irrigation diversion dams. The safety of these dams is not affected by the operation of NFSR Dam during either normal or emergency operations.

Therefore, interaction with other dams is not a concern of the normal operation of North Fork of the Smith River Dam.

EMERGENCY

If it appears that the North Fork of the Smith River Dam is about to breach, or during emergency operation, the dam operator will initiate the **North Fork of the Smith River Dam Emergency Action Plan.**

If it appears that the North Fork of the Smith River Dam will breach, the dam operator should notify the Montana Power Company 24-hour Dispatch Service for Rainbow Dam in Great Falls at **(406-453-5712 or 406-761-1101)**. However, if there is no answer, the Systems Operation Control Dispatch Center in Butte should be notified at **(406-494-4131, 406-494-4132 or 406-494-4133)**. When the flood wave from either a Clear Weather Breach or a Probable Maximum Flood breach reaches the mouth of the Smith River, the peak discharge into the Missouri River is estimated to be between 16,889 and 26,504 cfs.

INSPECTION AND MONITORING

The SWPB inspects the dam annually. Appendix B includes an example of a SWPB inspection report form. In addition to annual inspections, SWPB personnel will inspect the dam and reservoir during and after heavy runoff, after severe rainstorms and windstorms, during high storage periods, and after an earthquake. The embankment is monitored by instrumentation.

STRUCTURAL FEATURES INSPECTION

Structural features include the dam embankment, gate house, outlet works, and spillway (Figure 3). The SWPB inspects these structures annually as part of its inspection program. Items to be checked or noted include, but are not limited to:

1. Embankment
 - a. Erosion gullies in dam faces and abutments
 - b. Damage from burrowing animals or vegetation
 - c. Displacement or loss of riprap protection
 - d. Displacement of fill, sink holes, slumps, or other items
 - e. Any seepage on downstream face or base of embankment
2. Gatehouse -- any damage or vandalism
3. Outlet Works
 - a. Any differential settlement or movement resulting in cracking of the conduit
 - b. Erosion of the seals or concrete by cavitation immediately downstream of the operation gate
 - c. Major seepage of water into the conduit
 - d. Major deterioration of exposed concrete due to freeze/thaw cycles or sulfate reactions
 - e. Operation of both gates through a full cycle
 - f. Free, unobstructed operation of the air vent
 - g. Corrosion of any metal

- h. Proper lubrication and cleaning of the pedestals
- 4. Spillway
 - a. Deterioration of concrete
 - b. Separation or movement of joints
 - c. Erosion of the spillway chute, backfill behind the walls, or stilling basin.
 - d. Blockage of the approach or exit channel
 - e. Condition of the wood on the spillway crest
 - f. Condition of the spillway chute below the concrete portion of the spillway.

RIPRAP INSPECTION

The riprap along the front face of the dam should be at least 30 inches thick. Immediately after the occurrence of high water, SWPB personnel will inspect the riprap and determine if addition riprap is necessary.

TOE DRAIN

The drawings for the dam show that the toe drain consists of an 12-inch diameter drain tile buried in a French-drain-type gravel, about 12 feet deep at the base of the rock and gravel fill portion of the dam. The final quantities for the dam indicate that the drain tile was not installed, but this has not been verified. The drain exits to the left of the outlet structure in a French drain and also to the right of the outlet structure in the old stream channel. The drain appears to be functioning properly as no seepage has been observed above the drain. There has been no observed sediment in the seepage water.

MONITORING WELLS

In the spring of 1989, twenty two exploration holes were drilled at the dam. During the drilling, monitoring tubes were installed in 18 of the 22 bore holes -- seven in the embankment, three along the downstream toe, five in the abutments, and three along the south side of the reservoir. Figure 4 shows the general location of these monitoring wells. Soil profiles of the drill holes and details as to how the wells were constructed are shown in Appendix D.

SEEPAGE MONITORING

Seepage at the toe of the embankment is marked by a swampy willow infested area. A French drain on the left side of the outlet channel discharges a constant flow of water through a swampy area into the outlet channel. A "V-notch weir has been installed in this swampy area to measure the French drain discharge prior to the water discharging into the outlet channel. See V-notch weir discharge table in Appendix A.

A second "V-notch" weir is located to the right of the outlet structure to measure seepage from the wet area. The area appears to flow only when the reservoir is at or near full pool. See V-notch weir discharge table in Appendix A.

The monitoring wells and seepage areas at the dam are observed and monitored by the dam operator, DNRC Lewistown Regional Office, and SWPB during regular visits; and may be measured by the SWPB during annual inspections. The instruments are generally measured twice per month from May 1 to August 31, and once per month in March, April, September, and October. Measurements may be taken during the winter months (November, December, January, February) depending on weather conditions. The monitoring data is maintained by the SWPB in Helena.

MAINTENANCE

The association is responsible for routine maintenance of the project. In addition, the SWPB may identify items that need maintenance or repair during the annual inspection.

ROUTINE MAINTENANCE

To protect the dam and keep it in good working order, the dam operator during regular visits to the dam will watch for and identify any potential maintenance requirements. As soon as a need is identified, the dam operator needs to schedule and perform the routine maintenance.

Items that may need occasional attention include, but are not limited to:

1. *Lubrication and cleaning of gate-operating mechanisms.*
2. *Debris or silt restricting the spillway inlet or the outlet works.* Accumulated debris that could affect the operation of these appurtenances will be removed at once, with all debris removed at least annually.
3. *Erosion gullies on embankment.* Development of erosion gullies should be checked immediately. Gullies should be filled, compacted, and seeded. Particular attention should be paid to the abutment contact areas and the downstream face.
4. *Rodent damage.* The rodents will be removed or destroyed, and any burrows holes should be filled immediately.
5. *Upstream embankment slope riprap.* The upstream face riprap normally will be observed annually, but may occasionally need repairs because of high water or wave action.
6. *Vegetative cover on downstream slopes.* Good vegetative cover must be maintained, but large brush and willows should be removed.

7. *Noxious weeds.* Noxious weeds on and around the dam embankment and around the reservoir should be sprayed at least on an annual basis.
8. *Clean spillway and outlet structure wall tops.* Spillway and outlet structure wall tops should be clear of any dirt, rocks, grass, brush, and any overhanging vegetation or trees.
9. *Repair joints and seal cracks in the concrete structures.*
10. *Rock channel below concrete spillway.* Remove any willows, brush or large grass growing in the rock channel.
11. *Weirs and Flumes.* These devices will be maintained clean of sediment, algae, kept upright, free flowing and free of debris.

ANNUAL MAINTENANCE

The SWPB conducts annual inspections of the dam and reservoir. During these inspections, any items requiring annual maintenance will be identified and recorded. Items that may need annual maintenance include the dam embankment, spillway, outlet works, gates, riprap, roads and gatehouse. Other routine items needing immediate attention, such as the need to remove trees, willows, or brush, will also be noted.

After the inspection, the SWPB sends the association a Dam Safety Inspection Report and a Maintenance Schedule Report. The reports identify items that need maintenance and provide a schedule of when the maintenance tasks need to be completed. The association is responsible for performing the maintenance items within the times specified.

The dam operator or association members may perform these tasks. However, major repairs will likely to be handled by a contractor. The SWPB may assist in contracting for repairs and may supervise the repair work.

RECORD KEEPING

The SWPB maintains records, including photographs, of all inspections and maintenance requirements. These records also include seepage monitoring observations. Anyone who wants to review these records may do so in the SWPB's office at the Department of Natural Resources and Conservation in Helena.

The dam operator will keep records of the reservoir elevation, seepage observations or measurements, and any unusual conditions. These records may be reviewed at the dam operator's house.

REFERENCES

- U.S. Army Corp's of Engineers. April 1981. Phase 1 Inspection Report, National Dam Safety Program, North Fork Smith River Dam, White Sulfur Springs, Montana, Meagher County Mt 9. Prepared for the State of Montana (DNRC) by HKM Associates, Billings, Montana under the U.S. Army Corps of Engineers National Dam Safety Program.
- Howard Zehntner, Dam Operator. Personal communications, December 1994.
- Craig Dubois, Water Resources Specialist III, Lewistown Regional Office, DNRC. Personal communications, December 1994.
- HKM Associates. March 1993. Geotechnical Investigation - North Fork Smith River Rehabilitation Feasibility Study. Prepared for DNRC by HKM Associates, Billings, Montana.
- HKM Associates. March 1993. Hydrology and Water Availability Study - North Fork Smith River Rehabilitation Feasibility Study. Prepared for DNRC by HKM Associates, Billings, Montana.
- HKM Associates. March 1995. Draft North Fork Smith River Rehabilitation Feasibility Study. Prepared for DNRC by HKM Associates, Billings, Montana.

APPENDICES

APPENDIX A
RATING CURVES AND TABLES

**TABLE 1. SLOPE-ELEVATION-STORAGE TABLE
NORTH FORK SMITH RIVER RESERVOIR DAM**

New slope pins installed and elevations established by GPS kinematic methods 11/4/2000.
The 0+00 is 373 east of the old 0+00 and 9 feet down slope from a steel post in the
highway fence. A white fiberglass post was installed in the fence at this point.
The alignment is toward the spillway.

DISTANCE	ELEVATION	STORAGE		DISTANCE	ELEVATION	STORAGE
0+00 CAP	5492.34	12,860		37	5485.63	10,581
1	5492.01	12,730		38	5485.54	10,556
2	5491.69	12,605		39	5485.44	10,525
3	5491.47	12,519		40	5485.35	10,498
4	5490.96	12,320		41	5485.27	10,473
5	5490.56	12,163		42	5485.19	10,448
6	5490.15	12,003		43	5485.11	10,424
7	5489.99	11,941		44	5485.03	10,399
8	5489.82	11,875		45	5484.96	10,378
9	5489.65	11,822		46	5484.88	10,354
10	5489.49	11,773		47	5484.80	10,330
11	5489.32	11,721		48	5484.72	10,306
12	5489.16	11,671		49	5484.64	10,282
13	5488.39	11,434		0+50 CAP	5484.59	10,267
BOARDS	5488.30	11,406		50	5484.57	10,261
14	5488.29	11,403		51	5484.43	10,219
15	5488.20	11,376		52	5484.29	10,177
16	5488.10	11,345		53	5484.15	10,135
17	5488.00	11,314		54	5484.01	10,093
18	5487.90	11,283		55	5483.87	10,051
19	5487.80	11,252		56	5483.73	10,009
20	5487.70	11,221		57	5483.59	9,967
21	5487.56	11,178		58	5483.45	9,926
22	5487.42	11,135		59	5483.31	9,884
23	5487.28	11,092		60	5483.17	9,842
24	5487.14	11,049		61	5483.04	9,803
25	5487.00	11,006		62	5482.91	9,764
26	5486.86	10,963		63	5482.79	9,728
27	5486.72	10,893		64	5482.66	9,689
28	5486.58	10,877		65	5482.53	9,650
29	5486.44	10,834		66	5482.41	9,614
30	5486.30	10,791		67	5482.28	9,575
31	5486.20	10,760		68	5482.15	9,536
32	5486.11	10,732		69	5482.03	9,500
33	5486.01	10,701		70	5481.90	9,460
SPWAY CREST	5486.00	10,698		71	5481.77	9,421
34	5485.92	10,674		72	5481.64	9,382
35	5485.82	10,642		73	5481.51	9,343
36	5485.73	10,612		74	5481.38	9,305
DISTANCE	ELEVATION	STORAGE		DISTANCE	ELEVATION	STORAGE

TABLE 1. SLOPE-ELEVATION-STORAGE TABLE (continued)
NORTH FORK SMITH RIVER RESERVOIR DAM

DISTANCE	ELEVATION	STORAGE		DISTANCE	ELEVATION	STORAGE
75	5481.25	9,266		121	5476.23	7,825
76	5481.11	9,224		122	5476.12	7,794
77	5480.98	9,186		123	5476.00	7,760
80	5480.59	9,069		124	5475.89	7,729
81	5480.48	9,036		125	5475.78	7,698
82	5480.37	9,003		126	5475.67	7,666
83	5480.26	8,970		127	5475.55	7,633
84	5480.14	8,934		128	5475.44	7,602
85	5480.03	8,901		129	5475.33	7,570
86	5479.92	8,869		130	5475.22	7,539
87	5479.81	8,838		131	5475.12	7,511
88	5479.70	8,807		132	5475.03	7,486
89	5479.58	8,775		133	5474.93	7,459
90	5479.47	8,742		134	5474.84	7,435
91	5479.37	8,713		135	5474.74	7,409
92	5479.28	8,688		136	5474.65	7,386
93	5479.18	8,660		137	5474.55	7,360
94	5479.08	8,631		138	5474.45	7,334
95	5478.98	8,604		139	5474.36	7,311
96	5478.88	8,575		140	5474.26	7,285
97	5478.79	8,549		141	5474.14	7,253
98	5478.69	8,522		142	5474.03	7,224
99	5478.59	8,493		143	5473.91	7,193
1+00 CAP	5478.52	8,473		144	5473.79	7,162
100	5478.49	8,465		145	5473.67	7,131
101	5478.38	8,434		146	5473.55	7,100
102	5478.27	8,403		147	5473.43	7,069
103	5478.15	8,368		148	5473.32	7,040
104	5478.04	8,337		1+50 CAP	5473.31	7,038
105	5477.93	8,307		149	5473.20	7,009
106	5477.82	8,275		150	5473.07	6,975
107	5477.70	8,241		151	5472.95	6,944
108	5477.59	8,210		152	5472.84	6,915
109	5477.48	8,179		153	5472.72	6,883
110	5477.37	8,148		154	5472.61	6,856
111	5477.26	8,116		155	5472.50	6,826
112	5477.16	8,088		156	5472.38	6,795
113	5477.06	8,060		157	5472.27	6,766
114	5476.96	8,032		158	5472.15	6,735
115	5476.85	8,000		159	5472.04	6,706
116	5476.75	7,972		160	5471.93	6,678
117	5476.65	7,944		161	5471.81	6,646
118	5476.55	7,916		162	5471.69	6,615
119	5476.44	7,885		163	5471.57	6,584
120	5476.34	7,856		164	5471.45	6,553
DISTANCE	ELEVATION	STORAGE		DISTANCE	ELEVATION	STORAGE

TABLE 1. SLOPE-ELEVATION-STORAGE TABLE (continued)
NORTH FORK SMITH RIVER RESERVOIR DAM

DISTANCE	ELEVATION	STORAGE		DISTANCE	ELEVATION	STORAGE
165	5471.33	6,522		209	5466.37	5,321
166	5471.20	6,488		210	5466.26	5,295
167	5471.08	6,457		211	5466.13	5,264
168	5470.96	6,426		212	5466.00	5,234
169	5470.84	6,395		213	5465.87	5,203
170	5470.72	6,363		214	5465.75	5,175
171	5470.62	6,337		215	5465.62	5,144
172	5470.52	6,311		216	5465.49	5,114
173	5470.42	6,285		217	5465.36	5,083
174	5470.33	6,262		218	5465.23	5,053
175	5470.23	6,235		219	5465.11	5,024
176	5470.13	6,210		220	5464.98	4,993
177	5470.03	6,184		221	5464.85	4,965
178	5469.93	6,159		222	5464.72	4,935
179	5469.83	6,136		223	5464.60	4,909
180	5469.73	6,112		224	5464.47	4,880
181	5469.61	6,084		225	5464.34	4,850
182	5469.50	6,058		226	5464.21	4,821
183	5469.38	6,030		227	5464.09	4,795
184	5469.27	6,004		228	5463.96	4,765
185	5469.16	5,978		229	5463.83	4,735
186	5469.04	5,949		230	5463.71	4,710
187	5468.93	5,924		231	5463.60	4,685
188	5468.81	5,895		232	5463.50	4,662
189	5468.70	5,870		233	5463.39	4,637
190	5468.58	5,842		234	5463.29	4,615
191	5468.46	5,813		235	5463.18	4,591
192	5468.33	5,783		236	5463.08	4,568
193	5468.21	5,754		237	5462.97	4,543
194	5468.09	5,726		238	5462.87	4,521
195	5467.96	5,696		239	5462.77	4,498
196	5467.84	5,667		240	5462.66	4,473
197	5467.72	5,639		241	5462.53	4,444
198	5467.59	5,608		242	5462.40	4,415
199	5467.47	5,580		243	5462.27	4,386
2+00 CAP	5467.39	5,561		244	5462.14	4,356
200	5467.34	5,549		245	5462.02	4,329
201	5467.24	5,526		246	5461.89	4,300
202	5467.13	5,500		247	5461.76	4,271
203	5467.02	5,474		248	5461.63	4,242
204	5466.91	5,448		249	5461.50	4,213
205	5466.80	5,422		2+50 CAP	5461.38	4,186
206	5466.69	5,396		250	5461.37	4,184
207	5466.58	5,370		251	5461.27	4,162
208	5466.48	5,347		252	5461.16	4,137
DISTANCE	ELEVATION	STORAGE		DISTANCE	ELEVATION	STORAGE

TABLE 1. SLOPE-ELEVATION-STORAGE TABLE (continued)
NORTH FORK SMITH RIVER RESERVOIR DAM

DISTANCE	ELEVATION	STORAGE		DISTANCE	ELEVATION	STORAGE
253	5461.06	4,114		298	5455.93	3,060
254	5460.95	4,090		299	5455.82	3,038
255	5460.85	4,067		3+00 CAP	5455.78	3,030
256	5460.75	4,045		300	5455.71	3,016
257	5460.64	4,020		301	5455.60	2,994
258	5460.54	3,998		302	5455.48	2,969
259	5460.43	3,973		303	5455.36	2,945
260	5460.33	3,951		304	5455.24	2,921
261	5460.22	3,926		305	5455.12	2,897
262	5460.11	3,902		306	5455.00	2,874
263	5460.00	3,878		307	5454.89	2,855
264	5459.89	3,855		308	5454.77	2,834
265	5459.78	3,833		309	5454.65	2,814
266	5459.67	3,811		310	5454.53	2,794
267	5459.56	3,788		311	5454.39	2,771
268	5459.45	3,766		312	5454.25	2,747
269	5459.34	3,744		313	5454.12	2,725
270	5459.23	3,722		314	5453.98	2,702
271	5459.13	3,699		315	5453.84	2,678
272	5459.03	3,682		316	5453.70	2,655
273	5458.93	3,655		317	5453.57	2,633
274	5458.83	3,642		318	5453.43	2,610
275	5458.74	3,624		319	5453.29	2,586
276	5458.64	3,604		320	5453.15	2,562
277	5458.54	3,584		321	5453.03	2,542
278	5458.44	3,563		322	5452.91	2,522
279	5458.34	3,543		323	5452.79	2,502
280	5458.24	3,523		324	5452.66	2,480
281	5458.10	3,495		325	5452.54	2,460
282	5457.95	3,465		326	5452.42	2,440
283	5457.81	3,437		327	5452.30	2,420
284	5457.67	3,409		328	5452.18	2,400
285	5457.52	3,379		329	5452.05	2,378
286	5457.38	3,351		330	5451.93	2,357
287	5457.23	3,321		331	5451.83	2,340
288	5457.09	3,293		332	5451.73	2,323
289	5456.95	3,265		333	5451.62	2,305
290	5456.80	3,235		334	5451.52	2,289
291	5456.69	3,213		335	5451.42	2,272
292	5456.59	3,193		336	5451.32	2,255
293	5456.48	3,171		337	5451.21	2,236
294	5456.37	3,148		338	5451.11	2,219
295	5456.26	3,126		339	5451.01	2,203
296	5456.15	3,104		340	5450.91	2,186
297	5456.04	3,082		341	5450.80	2,167
DISTANCE	ELEVATION	STORAGE		DISTANCE	ELEVATION	STORAGE

TABLE 1. SLOPE-ELEVATION-STORAGE TABLE (continued)
NORTH FORK SMITH RIVER RESERVOIR DAM

DISTANCE	ELEVATION	STORAGE		DISTANCE	ELEVATION	STORAGE
342	5450.69	2,149		386	5445.68	1,424
343	5450.58	2,131		387	5445.57	1,409
344	5450.47	2,112		388	5445.47	1,394
345	5450.36	2,094		389	5445.36	1,379
346	5450.25	2,075		390	5445.25	1,363
347	5450.14	2,057		391	5445.14	1,347
348	5450.03	2,038		392	5445.03	1,331
349	5449.92	2,022		393	5444.91	1,319
350	5449.81	2,006		394	5444.80	1,308
3+50 CAP	5449.80	2,005		395	5444.69	1,297
351	5449.69	1,988		396	5444.58	1,286
352	5449.57	1,973		397	5444.47	1,275
353	5449.45	1,955		398	5444.35	1,262
354	5449.33	1,939		399	5444.24	1,251
355	5449.21	1,922		400	5444.13	1,241
356	5449.09	1,905		4+00 CAP	5444.04	1,232
357	5448.97	1,888		401	5444.02	1,229
358	5448.85	1,871		402	5443.91	1,218
359	5448.72	1,853		403	5443.81	1,208
360	5448.60	1,835		404	5443.70	1,198
361	5448.50	1,822		405	5443.59	1,187
362	5448.40	1,808		406	5443.49	1,175
363	5448.29	1,792		407	5443.38	1,164
364	5448.19	1,776		408	5443.27	1,153
365	5448.09	1,765		409	5443.17	1,143
366	5447.99	1,750		410	5443.06	1,132
367	5447.88	1,734		411	5442.98	1,124
368	5447.78	1,720		412	5442.89	1,115
369	5447.68	1,706		413	5442.81	1,107
370	5447.57	1,691		414	5442.73	1,099
371	5447.45	1,674		415	5442.64	1,090
372	5447.32	1,655		416	5442.56	1,082
373	5447.20	1,638		417	5442.48	1,073
374	5447.07	1,620		418	5442.39	1,064
375	5446.94	1,602		419	5442.31	1,056
376	5446.82	1,585		420	5442.23	1,048
377	5446.70	1,568		421	5442.14	1,039
378	5446.57	1,550		422	5442.05	1,030
379	5446.45	1,533		423	5441.96	1,021
380	5446.32	1,514		424	5441.87	1,012
381	5446.21	1,499		425	5441.78	1,003
382	5446.11	1,482		426	5441.69	994
383	5446.00	1,469		427	5441.60	985
384	5445.89	1,453		428	5441.51	976
385	5445.79	1,439		429	5441.42	966
DISTANCE	ELEVATION	STORAGE		DISTANCE	ELEVATION	STORAGE

TABLE 1. SLOPE-ELEVATION-STORAGE TABLE (continued)
NORTH FORK SMITH RIVER RESERVOIR DAM

[illegible]

TABLE 2. TOTAL STORAGE IN ACRE-FEET

NORTH FORK SMITH RIVER RESERVOIR

Elevation	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
5,415	0									
5,416										
5,417										
5,418										
5,419										
5,420	28	30	31	33	34	36	38	39	41	42
5,421	44	46	47	49	50	52	54	55	57	58
5,422	60	62	63	65	66	68	70	71	73	74
5,423	76	78	79	81	82	84	86	87	89	90
5,424	92	94	95	97	98	100	102	103	105	108
5,425	108	110	113	115	117	120	122	124	126	129
5,426	131	133	135	138	140	142	144	148	149	151
5,427	153	155	158	160	162	164	167	169	171	174
5,428	176	178	180	183	185	187	189	191	194	196
5,429	198	200	203	205	207	209	212	214	216	219
5,430	221	225	230	234	239	243	247	252	256	261
5,431	265	269	274	278	283	287	292	296	301	305
5,432	310	314	319	323	328	332	337	341	346	350
5,433	354	358	363	367	372	376	381	385	390	394
5,434	399	403	408	412	417	421	425	430	434	439
5,435	443	451	458	466	473	481	489	496	504	511
5,436	519	527	534	542	549	557	565	572	580	587
5,437	595	603	610	518	625	633	641	648	656	663
5,438	671	679	686	694	701	709	717	724	732	739
5,439	747	755	762	770	777	785	793	800	808	815
5,440	823	833	843	853	863	873	884	894	907	914
5,441	924	934	944	954	964	974	985	995	1,005	1,015
5,442	1,025	1,035	1,045	1,055	1,065	1,075	1,086	1,096	1,106	1,116
5,443	1,126	1,136	1,146	1,156	1,166	1,176	1,187	1,197	1,207	1,217
5,444	1,227	1,237	1,247	1,257	1,267	1,277	1,288	1,298	1,308	1,318
5,445	1,328	1,342	1,356	1,370	1,384	1,399	1,413	1,427	1,441	1,455
5,446	1,469	1,483	1,497	1,511	1,525	1,540	1,554	1,568	1,582	1,596
5,447	1,610	1,624	1,638	1,652	1,666	1,681	1,695	1,709	1,723	1,737
5,448	1,751	1,765	1,779	1,793	1,807	1,822	1,836	1,850	1,864	1,878
5,449	1,892	1,906	1,920	1,934	1,948	1,963	1,977	1,991	2,005	2,019
5,450	2,033	2,050	2,067	2,083	2,100	2,117	2,134	2,151	2,167	2,184
5,451	2,201	2,218	2,235	2,251	2,268	2,285	2,302	2,319	2,335	2,352
5,452	2,369	2,386	2,403	2,419	2,436	2,453	2,470	2,487	2,503	2,520
5,453	2,537	2,554	2,571	2,587	2,604	2,621	2,638	2,655	2,671	2,688
5,454	2,705	2,722	2,739	2,755	2,772	2,789	2,806	28,232	2,839	2,856
5,455	2,873	2,893	2,913	2,933	2,953	2,974	2,994	3,014	3,034	3,054

TABLE 2. TOTAL STORAGE IN ACRE-FEET (continued)

NORTH FORK SMITH RIVER RESERVOIR

Elevation	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
5,456	3,074	3,094	3,114	3,134	3,154	3,175	3,195	3,215	3,235	3,255
5,457	3,275	3,295	3,315	3,335	3,355	3,375	3,395	3,415	3,435	3,455
5,458	3,475	3,495	3,515	3,535	3,555	3,576	3,596	3,616	3,636	3,656
5,459	3,676	3,696	3,716	3,736	3,756	3,777	3,797	3,817	3,837	3,857
5,460	3,877	3,899	3,922	3,944	3,967	3,989	4,011	4,034	4,056	4,079
5,461	4,101	4,123	4,146	4,168	4,191	4,213	4,235	4,258	4,280	4,303
5,462	4,325	4,348	4,370	4,393	4,415	4,438	4,460	4,483	4,505	4,528
5,463	4,550	4,572	4,595	4,617	4,640	4,662	4,684	4,707	4,729	4,752
5,464	4,774	4,796	4,819	4,841	4,864	4,886	4,908	4,931	4,953	4,979
5,465	4,998	5,022	5,045	5,069	5,092	5,116	5,140	5,163	5,187	5,210
5,466	5,234	5,258	5,281	5,305	5,328	5,352	5,375	5,399	5,422	5,446
5,467	5,469	5,493	5,516	5,540	5,563	5,587	5,611	5,634	5,658	5,681
5,468	5,705	5,729	5,752	5,776	5,799	5,823	5,846	5,870	5,893	5,917
5,469	5,940	5,964	5,987	6,011	6,034	6,058	6,082	6,105	6,129	6,152
5,470	6,176	6,202	6,228	6,264	6,280	6,306	6,332	6,358	6,384	6,410
5,471	6,436	6,462	6,488	6,514	6,540	6,566	6,592	6,618	6,644	6,670
5,472	6,696	6,722	6,748	6,774	6,800	6,826	6,853	6,879	6,905	6,931
5,473	6,957	6,983	7,009	7,035	7,061	7,087	7,113	7,139	7,165	7,191
5,474	7,217	7,243	7,269	7,295	7,321	7,347	7,373	7,399	7,425	7,451
5,475	7,477	7,505	7,534	7,562	7,590	7,618	7,647	7,675	7,703	7,732
5,476	7,760	7,788	7,817	7,845	7,873	7,901	7,930	7,958	7,986	8,015
5,477	8,043	8,071	8,100	8,128	8,156	8,184	8,213	8,241	8,269	8,298
5,478	8,326	8,354	8,383	8,411	8,439	8,467	8,496	9,524	8,552	8,581
5,479	8,609	8,637	8,666	8,694	8,722	8,750	8,779	8,807	8,835	8,864
5,480	8,892	8,922	8,952	8,982	9,012	9,042	9,072	9,102	9,132	9,162
5,481	9,192	9,222	9,252	9,282	9,312	9,341	9,371	8,401	9,431	9,461
5,482	9,491	9,521	9,551	9,581	9,611	9,641	9,671	9,701	9,731	9,761
5,483	9,791	9,821	9,851	9,881	9,911	9,940	9,970	10,000	10,030	10,060
5,484	10,090	10,120	10,150	10,180	10,210	10,240	10,270	10,300	10,330	10,360
5,485	10,390	10,421	10,452	10,482	10,513	10,544	10,575	10,606	10,636	10,667
5,486	10,698	10,729	10,760	10,790	10,821	10,852	10,883	10,914	10,944	10,975
5,487	11,006	11,037	11,068	11,098	11,129	11,160	11,191	11,222	11,252	11,283
5,488	11,314	11,345	11,376	11,406	11,437	11,468	11,499	11,530	11,560	11,591
5,489	11,622	11,653	11,684	11,714	11,745	11,776	11,807	11,838	11,868	11,899
5,490	11,930									

NOTE: Storage table based on 1935 original hand surveys of the reservoir.

Spillway Crest (without flashboards) Elevation 5,486.0 feet Storage 10,698 acre-feet

Spillway Crest (with flashboards) Elevation 5,488.3 feet Storage 11,406 acre-feet

Dam Crest Elevation 5,495.9 feet Storage 14,200 acre-feet

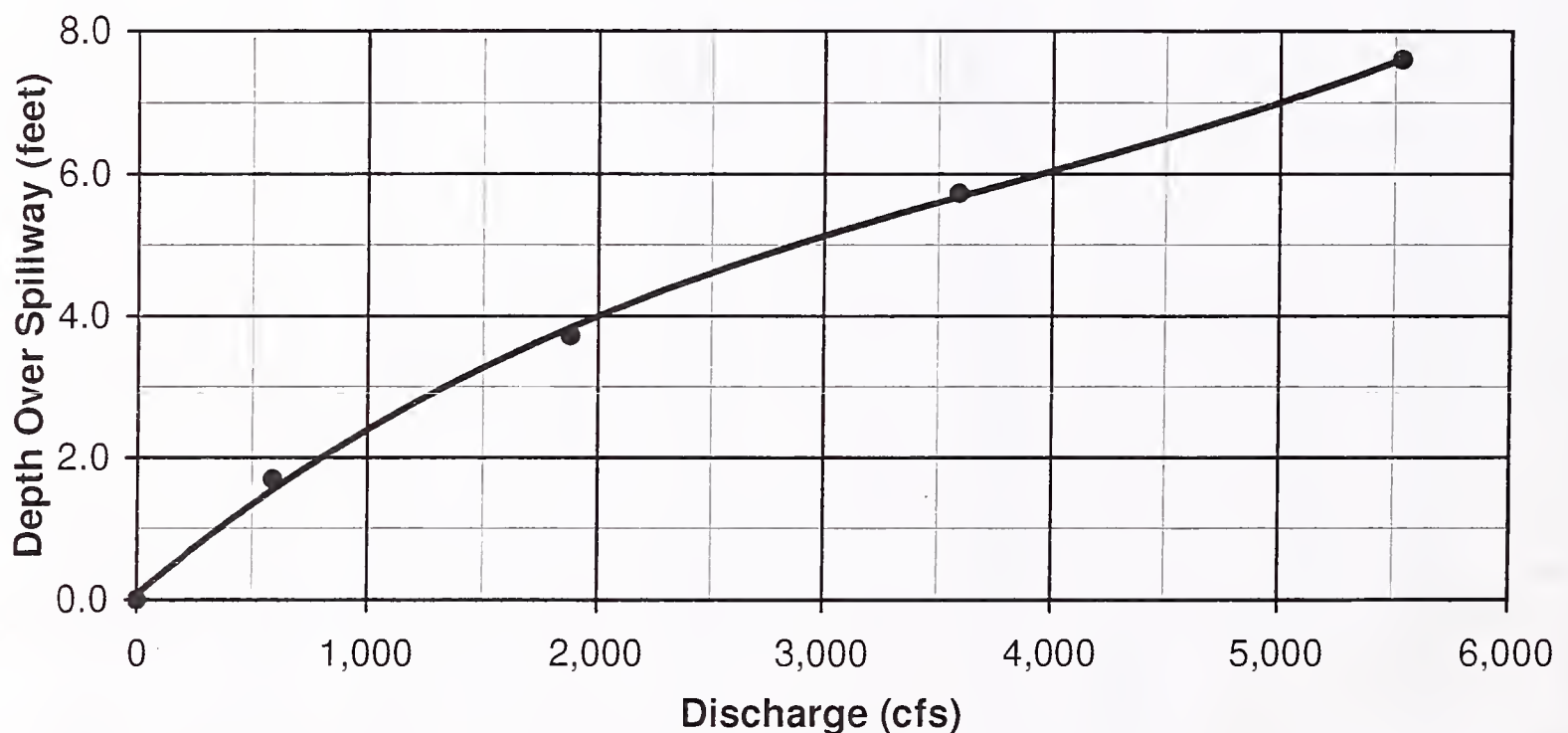
TABLE 3. SPILLWAY DISCHARGE

NORTH FORK SMITH RIVER RESERVOIR

Depth Over Crest (feet)	Elevation (feet)	Discharge (cfs)
0.0	5,488.3	0
1.7	5,490.0	590
3.7	5,492.0	1,880
5.7	5,494.0	3,590
7.6	5,495.9	5,530

Note: This rating table is for use when the flashboards are in place.

NORTH FORK SMITH RIVER DAM SPILLWAY RATING CURVE



Note: Data from the Corps of Engineers Phase 1 Inspection Report (1981).

TABLE 4. V-NOTCH WEIR RATING TABLE

HEAD	DISCHARGE			HEAD	DISCHARGE	
(IN)	(GPM)	(CFS)		(IN)	(GPM)	(CFS)
-----	-----	-----		4.1	77.8	0.173
-----	-----	-----		4.2	82.6	0.184
-----	-----	-----		4.3	87.5	0.195
-----	-----	-----		4.4	92.6	0.206
0.5	0.4	0.001		4.5	98.0	0.218
0.6	0.7	0.001		4.6	103.4	0.230
0.7	1.0	0.002		4.7	109.1	0.243
0.8	1.4	0.003		4.8	115.0	0.256
0.9	1.8	0.004		4.9	121.0	0.270
1.0	2.4	0.005		5.0	127.2	0.283
1.1	3.0	0.007		5.1	133.6	0.298
1.2	3.7	0.008		5.2	140.2	0.312
1.3	4.5	0.010		5.3	147.0	0.328
1.4	5.4	0.012		5.4	154.0	0.343
1.5	6.4	0.014		5.5	161.2	0.359
1.6	7.5	0.017		5.6	168.5	0.375
1.7	8.8	0.020		5.7	176.1	0.392
1.8	10.1	0.022		5.8	183.8	0.410
1.9	11.5	0.026		5.9	191.8	0.427
2.0	13.1	0.029		6.0	199.9	0.445
2.1	14.8	0.033		6.1	208.3	0.464
2.2	16.6	0.037		6.2	216.9	0.483
2.3	18.5	0.041		6.3	225.6	0.503
2.4	20.6	0.046		6.4	234.6	0.523
2.5	22.8	0.051		6.5	243.8	0.543
2.6	25.1	0.056		6.6	253.2	0.564
2.7	27.6	0.061		6.7	262.9	0.586
2.8	30.2	0.067		6.8	272.7	0.608
2.9	32.9	0.073		6.9	282.8	0.630
3.0	35.8	0.080		7.0	293.0	0.653
3.1	38.9	0.087		7.1	303.5	0.676
3.2	42.1	0.094		7.2	314.2	0.700
3.3	45.4	0.101		7.3	325.2	0.725
3.4	48.9	0.109		7.4	336.3	0.749
3.5	52.5	0.117		7.5	347.7	0.775
3.6	56.3	0.126		7.6	359.3	0.801
3.7	60.3	0.134		7.7	371.2	0.827
3.8	64.4	0.144		7.8	383.2	0.854
3.9	68.7	0.153		7.9	395.5	0.881
4.0	73.1	0.163		8.0	408.1	0.909

$$Q = (2.49 (H/12)^{2.48})(448.83)$$

Q in gpm

H in inches

APPENDIX B

INSPECTION REPORT FORM

DEPARTMENT OF NATURAL RESOURCES AND CONSERVATION
DAM SAFETY INSPECTION REPORT

NAME OF DAM _____
DATE INSPECTED _____

INVENTORY NO. _____
HAZARD CATEGORY _____
TYPE OF DAM _____
YEAR BUILT _____

OWNER _____
OPERATOR _____
STREAM _____
DRAINAGE AREA _____

Reservoir Storage Status

	Water Surface Elevation (feet)	Storage (acre-feet)
At time of inspection	_____	
At spillway crest	_____	
At min. dam crest elevation	_____	

ITEM	YES	NO	REMARKS
------	-----	----	---------

1. EMBANKMENT

A. Crest -- Height= Length= Width=

(1) Any visual settlements?			
(2) Any misalignments?			
(3) Any cracking?			
(4) Any traffic damage?			
(5) Other?			

ITEM	YES	NO	REMARKS
------	-----	----	---------

1. EMBANKMENT (continued)

B. Upstream Face -- Slope=

(1) Any erosion?			
(2) Any longitudinal cracks?			
(3) Any transverse cracks?			
(4) Is riprap protection adequate?			
(5) Any stone deterioration?			
(6) Any visual settlement, slumps, sloughing, depressions or bulges?			
(7) Adequate grass cover?			
(8) Debris on the dam face?			
(9) Other?			

C. Downstream Face--Slope=

(1) Any erosion?			
(2) Any longitudinal cracks?			
(3) Any transverse cracks?			
(4) Any visual settlement, slumps, sloughing, depressions or bulges?			
(5) Is the toe drain dry?			
(6) Are the relief wells flowing?			
(7) Any boils at the toe?			
(8) Any seepage areas?			
(9) Any traffic or animal damage?			
(10) Any burrowing animals?			
(11) Adequate grass cover?			
(12) Other?			

D. Amount and Type of Vegetation on the Dam

--

ITEM	YES	NO	REMARKS
------	-----	----	---------

2. ABUTMENT CONTACTS

A) Any erosion?			
B) Any visual differential movement?			
C) Any cracks?			
D) Any seepage present?			
E) Other?			

3. OUTLET WORKS

A. Intake Structure -- Size=

(1) Any settlement?			
(2) Any tilting?			
(3) Do concrete surfaces show:			
a. Spalling?			
b. Cracking?			
c. Erosion?			
d. Exposed reinforcement?			
(4) Do joints show:			
a. Displacement or offset?			
b. Loss of joint material?			
c. Leakage?			
(5) Metal appurtenances:			
a. Any corrosion present?			
b. Any breakage present?			
(6) Trash rack?			
a. Condition?			
b. Anchor system secure?			
(7) Other?			

ITEM	YES	NO	REMARKS
------	-----	----	---------

3. OUTLET WORKS (continued)

B. Conduit -- Type = _____ Size = _____

(1) Do concrete surfaces show:			
a. Spalling?			
b. Cracking?			
c. Erosion?			
d. Exposed reinforcement?			
(2) Do joints show:			
a. Displacement or offset?			
b. Loss of joint material?			
c. Leakage?			
(3) Is the conduit metal?			
a. Any corrosion present?			
b. Protective coatings adequate?			
(4) Is the conduit misaligned?			
(5) Any calcium deposits?			
(6) Other?			

C. Gates and Tower

(1) Gates:			
a. Size: Operating:	Emergency:		
b. Type: Operating:	Emergency:		
(2) Controls operational?			
(3) Controls lubricated?			
(4) Operational problems?			
(5) Leakage around gates?			
(6) Condition of gate seals?			
(7) Any cavitation damage? If so, describe?			
(8) Describe air vent-size and condition.			

ITEM	YES	NO	REMARKS
------	-----	----	---------

3. OUTLET WORKS (continued)

C. Gates and Tower (continued)

(9) Is there a jet pump?			
a. Is it operational?			
b. Leakage?			
(10) Is the tower dry? ____ wet?			
(11) Any seepage in the tower?			
(12) Condition of the tower?			
(13) Any safety problems?			
(14) Ladder in good condition?			
(15) Condition of the gatehouse?			
(16) Emergency plan completed for the dam?			
a. Posted in the gatehouse?			
(17) Other?			

D. Stilling Basin

(1) Do concrete surfaces show:			
a. Spalling?			
b. Cracking?			
c. Erosion?			
d. Exposed reinforcement?			
(2) Do joints show:			
a. Displacement or offset?			
b. Loss of joint material?			
c. Leakage?			
(3) Do energy dissipaters show:			
a. Signs of deterioration?			
b. Are they covered with debris?			
(4) Other?			

ITEM	YES	NO	REMARKS
------	-----	----	---------

3. OUTLET WORKS (continued)

E. Downstream Channel

(1) Is the channel:			
a. Eroding or backcutting?			
b. Sloughing?			
c. Obstructed?			
(2) Is released water:			
a. Undercutting the outlet?			
b. Eroding the embankment?			
(3) Other?			

4. SPILLWAY

A. Description

(1) Location?			
(2) Type of Spillway?			
(3) Size of Spillway?			
(4) Spillway lining?			
(5) Is there a weir?			
(6) Is the spillway in good condition?			
(7) Any drains?			
a. Describe the condition of drains.			

B. Does spillway show:

(1) Any cracking concrete?			
(2) Any spalling concrete?			
(3) Any exposed reinforcement in the concrete?			
(4) Any erosion?			

ITEM	YES	NO	REMARKS
------	-----	----	---------

4. SPILLWAY (continued)

4. B. Does spillway show: (continued)

(5) Any slope sloughing?			
(6) Any obstructions?			
(7) Displacement or offset joints?			
(8) Loss of joint material?			
(9) Leakage at the joints?			
(10) Other?			

C. Do the energy dissipaters show:

(1) Signs of deterioration?			
(2) Any cracking?			
(3) Any spalling?			
(4) Any exposed reinforcement?			
(5) Are they covered with debris?			
(6) Other?			

D. Has release water:

(1) Eroded the embankment?			
(2) Undercut the outlet?			
(3) Eroded the downstream channel?			
(4) Other?			

E. Emergency Spillway

(1) Is there an emergency spillway?			(If YES, describe)

ITEM	YES	NO	REMARKS
------	-----	----	---------

5. RESERVOIR CONTROL

A) Recent upstream development?			
B) Recent downstream development?			
C) Slides in reservoir area?			
D) Change in reservoir operation?			
E) Large impoundment upstream?			
F) Any debris in the reservoir?			
G) Other?			

6. INSTRUMENTATION

A) List type(s) of instrumentation:			
B) In good condition?			
C) Read periodically?			
D) Is data available?			
E) Include all data gathered since last report.			

7. DOWNSTREAM CONDITION

A. Downstream Land Use.

--

This dam was inspected by:

Additional comments and recommendations.

APPENDIX C
DISTRIBUTION LIST

O&M MANUAL DISTRIBUTION LIST

NORTH FORK OF THE SMITH RIVER

	<u>Number of Copies</u>
1. State Water Projects Bureau Glen McDonald Greg Ames (vacant) Art Taylor Bob Arrington Bob Clark Delores Eustic	7
2. DNRC Information Services	1
3. DNRC Lewistown Regional Office Scott Irvin Sterling Sundheim	2
4. DNRC Dam Safety	1
5. Water Users Trent Townsend – President Mark Ogle – Vice President Florence McAfee – Secretary-Treasurer Howard Zehntner – Dam Operator Gatehouse	5
6. State Library – Atten: Roberta Gebhardt	4
7. Extra	2
<hr/> TOTAL	<hr/> 22

APPENDIX D
MONITORING WELLS

INFORMATIONAL GOALS OF EXPLORATION HOLES AND TEST PITS

<u>Hole/Test Pit No.</u>	<u>Purpose</u>
DH-101	To evaluate the subsurface conditions for a potential auxiliary spillway on the left abutment.
DH-102	To determine the conditions in the left abutment.
DH-103 & DH-114	To identify the potentiometric surface at the toe of the embankment and to obtain samples of the soils for stability analysis.
DH-104 & DH-115	To establish a monitoring hole on the downstream face of the dam and determine the embankment soil characteristics.
DH-105 & DH-116	To determine the character of the zoned embankment and to monitor the location of the phreatic surface.
DH-106	To evaluate the foundation conditions at the upstream toe.
DH-107	To determine the character of the embankment and to establish a monitoring hole.
DH-108	To evaluate the right abutment.
DH-109	To evaluate foundation conditions for a potential guard dike.
DH-110 & DH-111	To evaluate the potential for construction on the impermeable section at the potential auxiliary spillway location.
DH-112 & DH-113	To evaluate the existing highway embankment for stability if the reservoir pool is raised.
DH-117	To evaluate the potential for retaining dike and auxillary spillway
TP-201 through TP-203	To investigate potential borrow sources.
TP-204 through TP-209	To investigate the overburden and depth to bedrock in the area of the potential auxiliary spillway.
TP-210	Investigation of seepage at the downstream toe.

Note: Information from Geotechnical Investigation - North Fork Smith River Rehabilitation Feasibility Study. Prepared for DNRC by HKM Associates, Billings, Montana in March 1993.



D3

Project No. 84087.137	10 No.	Date SEPT. 1992	Designed	Drawn <i>MLC</i>	Checked	Approved
NORTH FORK SMITH RIVER DAM						
GEOTECHNICAL INVESTIGATION						
LOCATIONS OF EXPLORATION HOLES						
No.	Revision	By	Date			

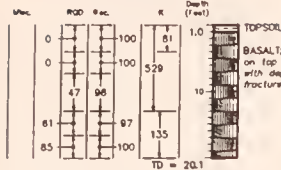
HKA ASSOCIATES
ENGINEERS-PLANNERS

Branch Offices:
 2727 Central Avenue
 • Bozeman, Montana
 P.O. Box 31318
 • Sheridan, Wyoming
 Billings, Montana 59107

Sheet No.
1
 of 8

DRILL HOLE No. 101 (DH-101)

LOCATION: 9108.2 N, 9570.3 E
ELEVATION: 5498.3

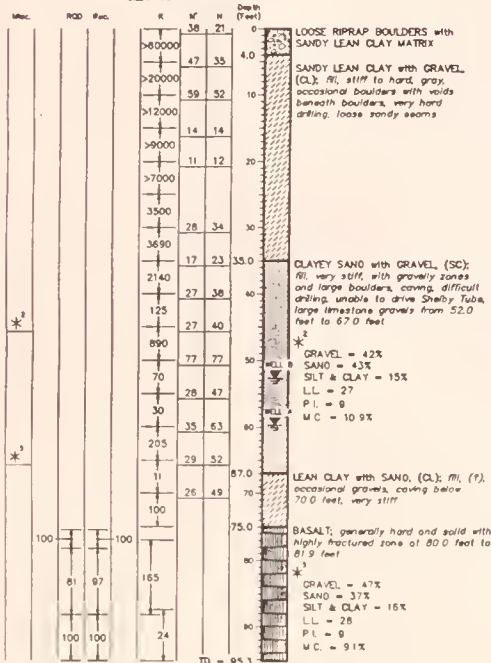


COMPLETION: 3/23/89
PVC Cap on Slotted 3/4" # Sch. 40 PVC (20' - 15.0').
Solid 3/4" # Sch. 40 PVC (15.0' - 0.0')

Gravel Pack (20' - 9.5'), Bentonite (9.5' - 2.0'), Grout (2.0' - 0.0'), 2" # Black Steel Pipe Surface Casing with threaded and gas-lifted watertight cap

DRILL HOLE No. 104 (DH-104)

LOCATION: 9784.8 N, 9877.4 E
ELEVATION: 5478.1



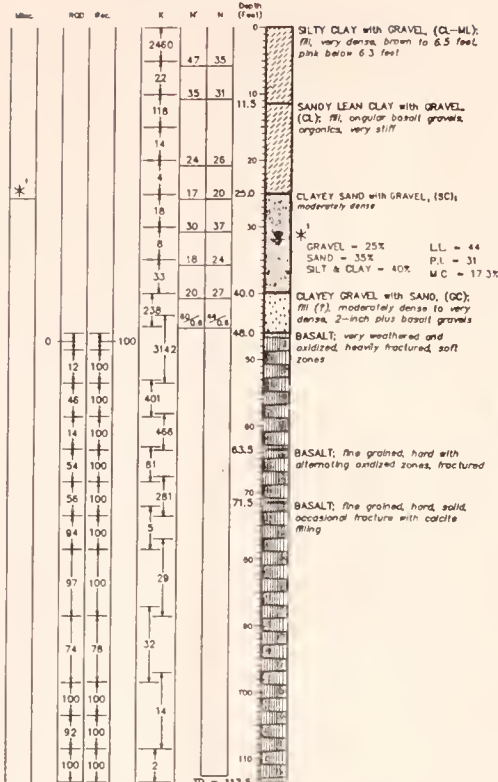
COMPLETION: 5/2/89
WELL B PVC Cap on Slotted 3/4" # Sch. 40 PVC (85.3' - 85.3').
Solid 3/4" # Sch. 40 PVC (85.3' - 0.0')

Gravel Backfill (85.3' - 80.0'), Bentonite (80.0' - 78.0').
Gravel Backfill (78.0' - 63.0'), Bentonite (63.0' - 62.0').
Gravel Pack (62.0' - 61.0')

WELL A Piezometer (81.0'), Solid 3/4" # Sch. 40 PVC (61.0' - 0.0').
Cave (61.0' - 35.0'), Gravel Backfill (35.0' - 4.0'), Bentonite (4.0' - 1.0'), Grouted Manhole Surface Casing

DRILL HOLE No. 102 (DH-102)

LOCATION: 9472.7 N, 9828.8 E
ELEVATION: 5496.3

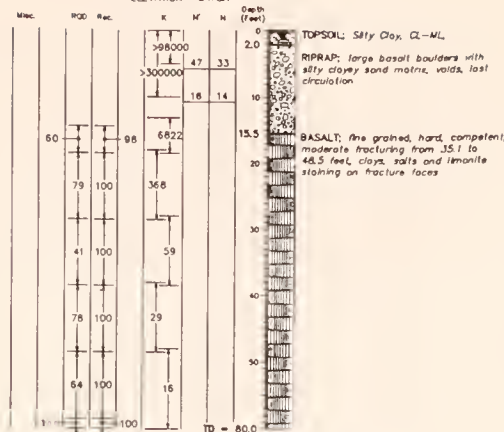


COMPLETION: 5/15/89
PVC Cap on Slotted 3/4" # Sch. 40 PVC (113.5' - 93.5').
Solid 3/4" # Sch. 40 PVC (93.5' - 0.0')

Gravel Pack (113.5' - 10.0'), Bentonite (10.0' - 0.0'), 2" # Black Steel Pipe Surface Casing with threaded and gas-lifted watertight cap

DRILL HOLE No. 103 (DH-103)

LOCATION: 9807.8 N, 9748.2 E
ELEVATION: 5418.1

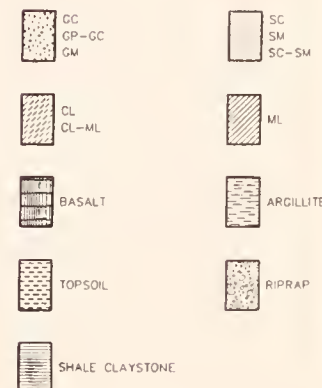


COMPLETION: 5/22/89
PVC Cap on Slotted 3/4" # Sch. 40 PVC (60.0' - 50.0').
Solid 3/4" # Sch. 40 PVC (50.0' - 0.0')

Gravel Pack (60.0' - 44.2'), 1/4" # Bentonite Tablets (44.2' - 39.0'), Gravel Backfill (39.0' - 15.0'), Cave (15.0' - 0.0'), Medium Bentonite Chips (6.0' - 4.0'), Grouted Manhole Surface Casing

LEGEND

- * INDICATES LOCATION OF SAMPLE ON WHICH LAB TESTS WERE MADE. RESULTS ARE INCLUDED IN TEXT OF LOG. THE NUMBER REFERS TO THE PLATE NUMBER IN THE APPENDIX ON WHICH ADDITIONAL INFORMATION IS PRESENTED
- RECORDED GROUND WATER LEVEL (6-13-89)
- TD TOTAL DEPTH
- N NUMBER OF BLOWS REQUIRED TO DRIVE A STANDARD 2-INCH DIAMETER SPLIT SPOON PENETROMETER 12 INCHES INTO THE SOIL BY A 140-POUND HAMMER DROPPING FREELY AT A DISTANCE OF 30 INCHES
- N STANDARD PENETRATION VALUE CORRECTED FOR EFFECTIVE OVERBURDEN STRESS AND SAMPLE DIAMETER
- Rec. RECOVERY (PERCENT)
- ROO ROCK QUALITY DESIGNATION (PERCENT) FROM CORE SAMPLES
- K FIELD PERMEABILITY IN FT./YR (U.S.B.R. DESIGNATION E-18)
- Compl. COMPLETION
- LL LIQUID LIMIT (PERCENT)
- P.I. PLASTIC INDEX
- γ_d DRY UNIT WEIGHT (LBS./CU. FT.)
- ϕ INTERNAL ANGLE OF FRICTION (DEGREES)
- c COHESION (LBS./SQ. IN.)
- M.C. NATURAL SOIL MOISTURE CONTENT (PERCENT)
- Misc. MISCELLANEOUS



HKAM ASSOCIATES
ENGINEERS-PLANNERS

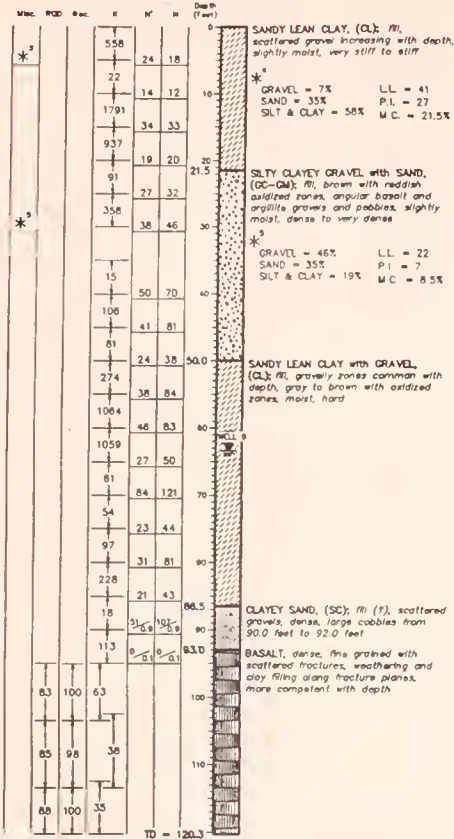
Branch Offices:
Bozeman, Montana
P.O. Box 31318
Billings, Montana 59107

Project No. 98087.137 ID No. 101
Date: JULY 1988
Designed: Drawn: Checked: Approved:
By: Revision: Date:
1. 9/18/92
2. 12/18/92

**NORTH FORK SMITH RIVER DAM
GEOTECHNICAL INVESTIGATION
LOGS OF EXPLORATION HOLES
DRILL HOLE No. 101 thru DRILL HOLE No. 104**

DRILL HOLE No. 105 (DH-105)

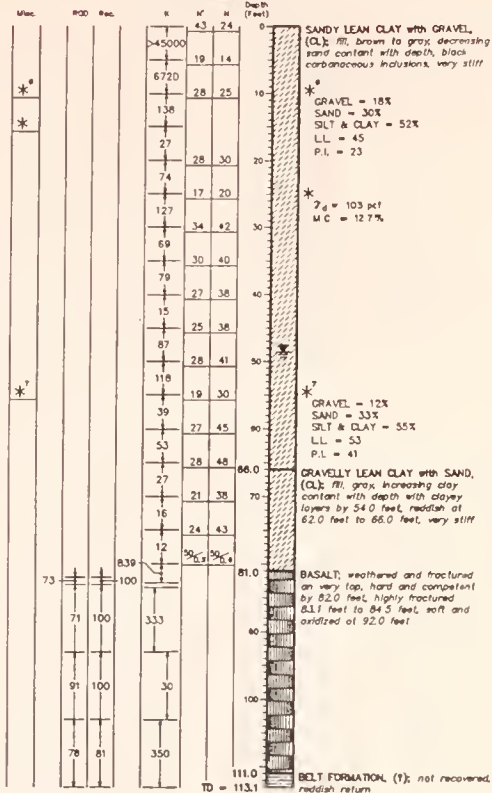
LOCATION 9784.0 N, 9915.9 E
ELEVATION 5486.7



COMPLETION 5/18/89
WELL A PVC Cap on Slotted 3/4" x Sch. 40 PVC (120.3' - 110.3'), Solid 3/4" x Sch. 40 PVC (110.3' - 0.0')
Gravel Backfill (120.3' - 95.0'), 1/4" x Bentonite Tablets, (95.0' - 86.0'), Unknown (86.0' - 62.0')
WELL B Piezometer (70.0'), Solid 3/4" x Sch. 40 PVC (69.0' - 0.0')
1/4" x Bentonite Tablets (62.0' - 55.0'), Gravel Backfill (55.0' - 10.0'), Medium Bentonite Chips (10.0' - 5.0')

DRILL HOLE No. 106 (DH-106)

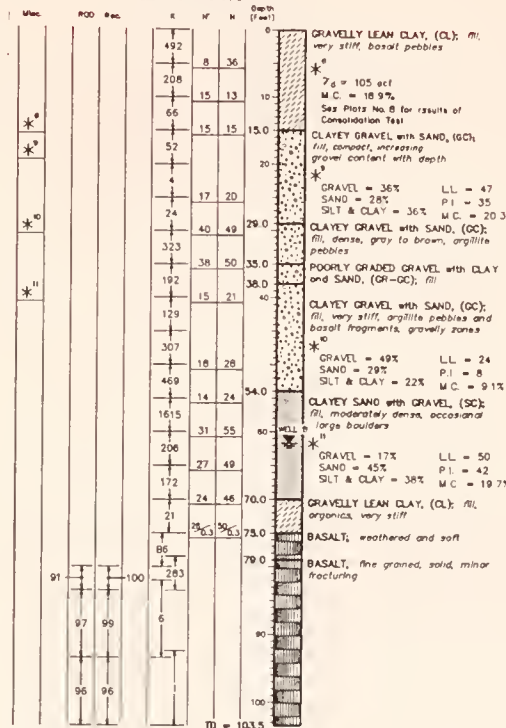
LOCATION 9741.4 N, 9949.2 E
ELEVATION 5488.9



COMPLETION 4/27/89
WELL A PVC Cap on Slotted 3/4" x Sch. 40 PVC (60.0' - 50.0'), Solid 3/4" x Sch. 40 PVC (50.0' - 0.0')
Backfill (113.1' - 84.0'), Bentonite (84.0' - 60.0'), Gravel Pack (80.0' - 44.0'), Bentonite (44.0' - 40.0'), Backfill (40.0' - 7.0'), Bentonite (7.0' - 2.0'), Black Steel Pipe Surface Casing with threaded and gassealed watertight cap

DRILL HOLE No. 107 (DH-107)

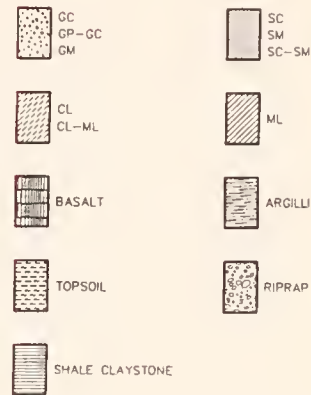
LOCATION 9913.0 N, 9987.8 E
ELEVATION 5486.5



COMPLETION 5/12/89
WELL B Slotted 3/4" x Sch. 40 PVC (103.5' - 93.0'), Solid 3/4" x Sch. 40 PVC (93.0' - 0.0')
Gravel Backfill (103.5' - 76.5'), Bentonite (76.5' - 74.0'), Core (74.0' - 62.0'), Bentonite (62.0' - 58.3'), Gravel Backfill (58.3' - 57.3')
WELL A Piezometer (57.3'), Solid 3/4" x Sch. 40 PVC (55.3' - 0.0')
Gravel Backfill (57.3' - 53.0'), Bentonite (53.0' - 50.5'), Gravel Backfill (50.5' - 10.0'), Bentonite (10.0' - 1.0'), Gravelled Manhole Surface Casing

LEGEND

- * INDICATES LOCATION OF SAMPLE ON WHICH LAB TESTS WERE MADE. RESULTS ARE INCLUDED IN TEXT OF LOG. THE NUMBER REFERS TO THE PLATE NUMBER IN THE APPENDIX ON WHICH ADDITIONAL INFORMATION IS PRESENTED
- TD RECORDED GROUND WATER LEVEL (6-13-89)
- TD TOTAL DEPTH
- N NUMBER OF BLOWS REQUIRED TO DRIVE A STANDARD 2-INCH DIAMETER SPT 30" PENETROMETER 12 INCHES INTO THE SOIL BY A 140-POUND HAMMER DROPPING FREELY A DISTANCE OF 30 INCHES
- N' STANDARD PENETRATION VALUE CORRECTED FOR EFFECTIVE OVERBURDEN STRESS AND SAMPLE DIAMETER
- Rec RECOVERY (PERCENT)
- ROO ROCK QUALITY DESIGNATION (PERCENT) FROM CORE SAMPLES
- K FIELD PERMEABILITY IN FT./YR (U.S.B.R. DESIGNATION E-18)
- Compl. COMPLETION
- LL LIQUID LIMIT (PERCENT)
- P.I. PLASTIC INDEX
- 7_d DRY UNIT WEIGHT (LBS./CU. FT.)
- φ INTERNAL ANGLE OF FRICTION (DEGREES)
- c COHESION (LBS./SQ IN.)
- M.C. NATURAL SOIL MOISTURE CONTENT (PERCENT)
- Misc. MISCELLANEOUS



HKA ASSOCIATES
ENGINEERS-PLANNERS

Branch Offices:
Airport Industrial Park
P.O. Box 31318
Billings, Montana 59107

**NORTH FORK SMITH RIVER DAM
GEOTECHNICAL INVESTIGATION
LOGS OF EXPLORATION HOLES
DRILL HOLE No. 105 thru DRILL HOLE No. 107**

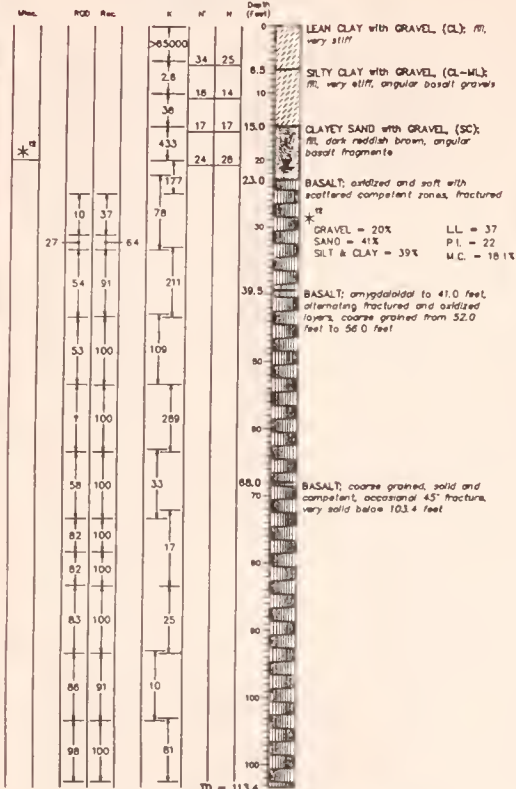
Project No. 89087.137 1D No. 100

Date JULY 1989 Designed _____ Drawn _____ Checked _____ Approved _____

Date	By	Revision
5/8/92		1
5/11/92		2

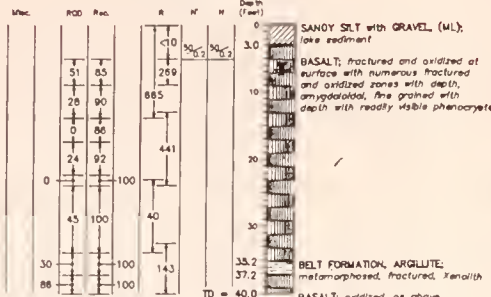
ORILL HOLE No. 108 (OH-108)

LOCATION : 10273.2 N, 10119.8 E
ELEVATION : 5485.8



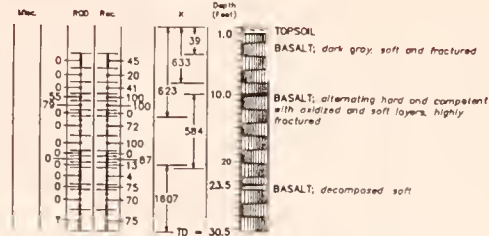
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LOCATION : 10526.8 N, 10238.5 E
ELEVATION : 5482.0



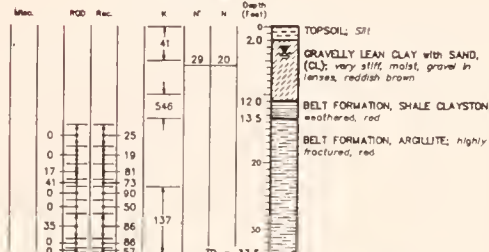
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LOCATION : 10648.2 N, 10347.8 E
ELEVATION : 5510.0



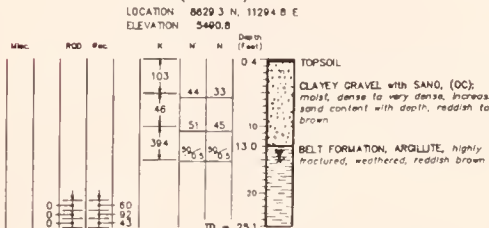
ORILL HOLE No. 112 (OH-112)

LOCATION : 8666.0 N, 10792.8 E
ELEVATION : 5486.0



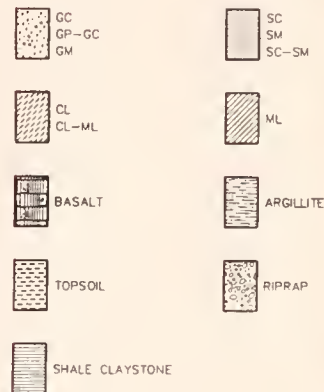
ORILL HOLE No. 113 (OH-113)

LOCATION : 8629.3 N, 11294.8 E
ELEVATION : 5440.8



LEGEND

- * INDICATES LOCATION OF SAMPLE ON WHICH LAB TESTS WERE MADE. RESULTS ARE INCLUDED IN TEXT OF LOG. THE NUMBER REFERS TO THE PLATE NUMBER IN THE APPENDIX ON WHICH ADDITIONAL INFORMATION IS PRESENTED.
- RECORDED GROUND WATER LEVEL (8-13-89)
- TOTAL DEPTH
- NUMBER OF BLOWS REQUIRED TO DRIVE A STANDARD 2-INCH DIAMETER SPT SPOON PENETROMETER 12 INCHES INTO THE SOIL BY A 140-POUND HAMMER DROPPING FREELY A DISTANCE OF 30 INCHES
- STANDARD PENETRATION VALUE CORRECTED FOR EFFECTIVE OVERBURDEN STRESS AND SAMPLE DIAMETER
- RECOVERY (PERCENT)
- ROCK QUALITY DESIGNATION (PERCENT) FROM CORE SAMPLES
- FIELD PERMEABILITY IN FT./YR (U.S.B.R. DESIGNATION E-18)
- COMPLETION
- LIQUID LIMIT (PERCENT)
- PLASTIC INDEX
- DRY UNIT WEIGHT (LBS./CU. FT.)
- INTERNAL ANGLE OF FRICTION (DEGREES)
- COHESION (LBS./SQ. IN)
- NATURAL SOIL MOISTURE CONTENT (PERCENT)
- MISCELLANEOUS



HKA ASSOCIATES
ENGINEERS-PLANNERS

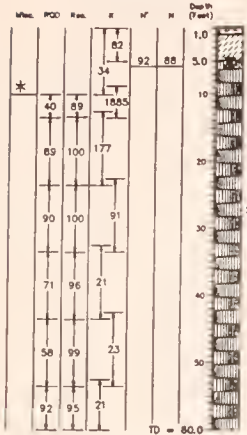
Branch Offices:
Bozeman, Montana
P.O. Box 31318
Billings, Montana 59107

Project No.	84087.137	ID No.	Date	July 1988	Designed	Drawn	Checked	Approved
No.								
Revision								
By								
Date								

NORTH FORK SMITH RIVER DAM
GEOTECHNICAL INVESTIGATION
LOGS OF EXPLORATION HOLES
DRILL HOLE No. 108 thru DRILL HOLE No. 113

DRILL HOLE No. 114
(DH-114)

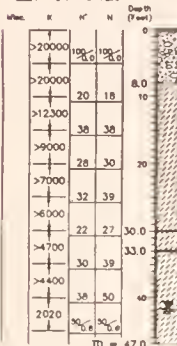
LOCATION 10021.4 N, 9820.2 E
ELEVATION: 5421.1



COMPLETION 5/20/89
PVC Cap on Slotted 3/4" Sch. 40 PVC (60.0' - 50.0'), Solid 3/4" Sch. 40 PVC (50.0' - 0.0')
Gravel Backfill (80.0' - 43.5'), 1/4" Bentonite Tablets (43.5' - 37.0')
Gravel Backfill (37.0' - 9.0'), Medium Bentonite Chips (9.0' - 4.0'), Steel Pipe Surface Casing with threaded and gasketed watertight cap

DRILL HOLE No. 115
(DH-115)

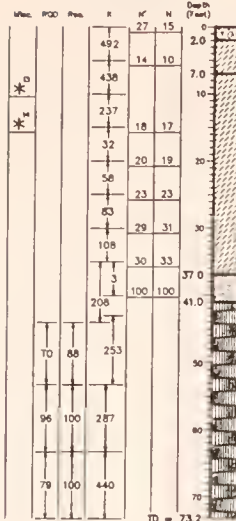
LOCATION 10002.0 N, 9948.7 E
ELEVATION: 5472.0



COMPLETION 5/2/89
PVC Cap on Slotted 3/4" Sch. 40 PVC (47.0' - 37.0'), Solid 3/4" Sch. 40 PVC (37.0' - 0.0')
Gravel Backfill (47.0' - 7.0'), Bentonite (7.0' - 0.0'), Steel Pipe Surface Casing with threaded and gasketed watertight cap

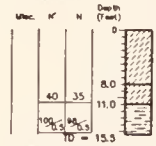
DRILL HOLE No. 116
(DH-116)

LOCATION 9946.9 N, 10078.2 E
ELEVATION: 5487.7



DRILL HOLE No. 119
(DH-119)

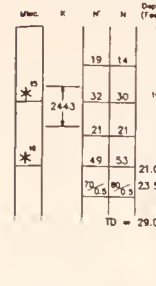
LOCATION: 8733.5 N, 11323.4 E
ELEVATION: 5519.7



COMPLETION 5/25/89
Backfilled with cuttings and borrow from ground surface in immediate area

DRILL HOLE No. 118
(DH-118)

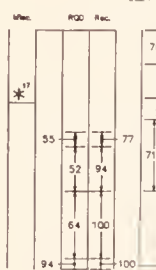
LOCATION: 8574.5 N, 10811.5 E
ELEVATION: 5514.8



COMPLETION 5/25/89
PVC Cap on Slotted 3/4" Sch. 40 PVC (29.0' - 19.0'), Solid 3/4" Sch. 40 PVC (19.0' - 0.0')
Select Backfill (29.0' - 6.0'), Bentonite (6.0' - 0.0'), Steel Pipe Surface Casing with threaded and gasketed watertight cap

DRILL HOLE No. 120
(DH-120)

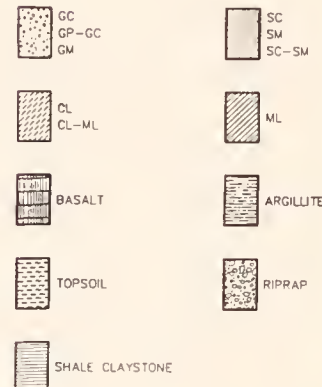
LOCATION 9682.5 N, 9730.3 E
ELEVATION: 5428.3



COMPLETION 5/28/89
PVC Cap on Slotted 3/4" Sch. 40 PVC (35.4' - 20.4'), Solid 3/4" Sch. 40 PVC (20.4' - 0.0')
Gravel Backfill (35.4' - 13.0'), Bentonite (13.0' - 4.0'), Gravel Base for Concrete Cap (4.0' - 0.0'), Steel Pipe Surface Casing with threaded and gasketed watertight cap

LEGEND

- *⁴ INDICATES LOCATION OF SAMPLE ON WHICH LAB TESTS WERE MADE. RESULTS ARE INCLUDED IN TEXT OF LOG. THE NUMBER REFERS TO THE PLATE NUMBER IN THE APPENDIX ON WHICH ADDITIONAL INFORMATION IS PRESENTED
- RECORDED GROUND WATER LEVEL (6-13-89)
- TD TOTAL DEPTH
- N NUMBER OF BLOWS REQUIRED TO DRIVE A STANDARD 2-INCH DIAMETER SPLIT SPOON PENETROMETER 12 INCHES INTO THE SOIL BY A 140-POUND HAMMER DROPPING FREELY A DISTANCE OF 30 INCHES
- N' STANDARD PENETRATION VALUE CORRECTED FOR EFFECTIVE OVERBURDEN STRESS AND SAMPLE DIAMETER
- Rec RECOVERY (PERCENT)
- ROO ROCK QUALITY DESIGNATION (PERCENT) FROM CORE SAMPLES
- K FIELD PERMEABILITY IN FT/VR (U.S.B.R. DESIGNATION E-18)
- Compl COMPLETION
- LL LIQUID LIMIT (PERCENT)
- P.I. PLASTIC INDEX
- 7_g DRY UNIT WEIGHT (LBS./CU. FT.)
- φ INTERNAL ANGLE OF FRICTION (DEGREES)
- c COHESION (LBS./SQ. IN.)
- W.C. NATURAL SOIL MOISTURE CONTENT (PERCENT)
- Misc. MISCELLANEOUS
- Qu UNCONFINED COMPRESSIVE STRENGTH (LBS./SQ. FT.)



Project No. 8807.137		Date JULY 1988		Designed		Checked		Approved	
By		Date		Revision		Location		Date	
1		9/8/92		1		10021.4 N, 9820.2 E		9/8/92	
2		9/8/92		2		10002.0 N, 9948.7 E		9/8/92	
3		9/8/92		3		8733.5 N, 11323.4 E		9/8/92	
4		9/8/92		4		8574.5 N, 10811.5 E		9/8/92	
5		9/8/92		5		9682.5 N, 9730.3 E		9/8/92	

HIK ASSOCIATES
ENGINEERS-PLANNERS

Branch Offices:
Airport Industrial Park
P.O. Box 31318
Bozeman, Montana
Billings, Montana 59107

Sheet No.

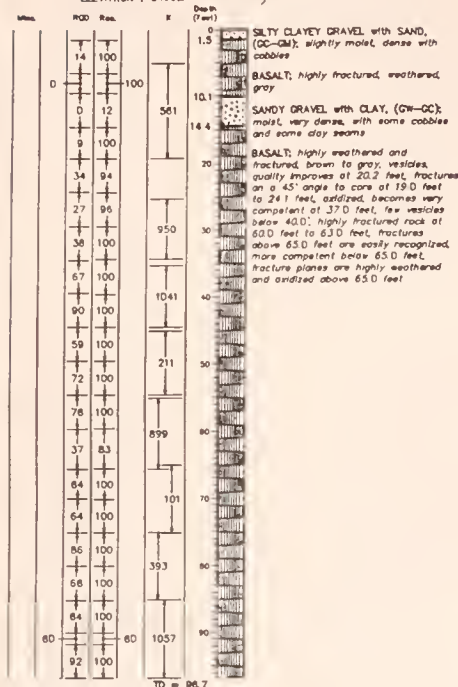
5

of 8

D11

DRILL HOLE No. 121 (DH-121)

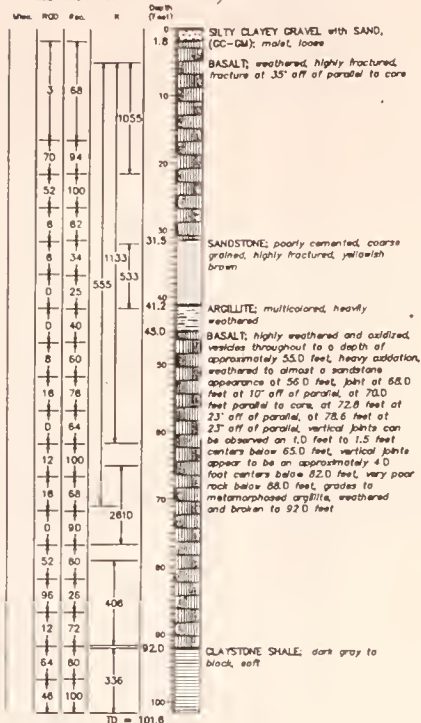
DRILLED AT AN ANGLE OF 25°
AT A BEARING OF S 38° 30' E
LOCATION 10430± N, 10200± E
ELEVATION : 5406± ELEVATION AND COORDINATES
ARE ONLY APPROXIMATE



COMPLETION :
6/23/89 Bentonite (96.7' - 0.0')

DRILL HOLE No. 122 (DH-122)

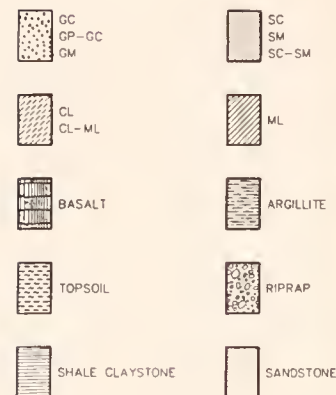
DRILLED AT AN ANGLE OF 24°
AT A BEARING OF N 84° 30' E
LOCATION 9340± N, 9735± E
ELEVATION : 5497± ELEVATION AND COORDINATES
ARE ONLY APPROXIMATE



COMPLETION :
8/24/89 Bentonite (101.8' - 0.0')

LEGEND

- * INDICATES LOCATION OF SAMPLE ON WHICH LAB TESTS WERE MADE. RESULTS ARE INCLUDED IN TEXT OF LOG. THE NUMBER REFERS TO THE PLATE NUMBER IN THE APPENDIX ON WHICH ADDITIONAL INFORMATION IS PRESENTED
- RECORDED GROUND WATER LEVEL (6-13-89)
- TOTAL DEPTH
- NUMBER OF BLOWS REQUIRED TO DRIVE A STANDARD 2-INCH DIAMETER SPLIT SPOON PENETROMETER 12 INCHES INTO THE SOIL BY A 140-POUND HAMMER DROPPING FREELY A DISTANCE OF 30 INCHES
- STANDARD PENETRATION VALUE CORRECTED FOR EFFECTIVE OVERBURDEN STRESS AND SAMPLE DIAMETER
- RECOVERY (PERCENT)
- ROCK QUALITY DESIGNATION (PERCENT) FROM CORE SAMPLES
- FIELD PERMEABILITY IN FT/YR (U.S.B.R DESIGNATION E-18)
- COMPLETION
- LIQUID LIMIT (PERCENT)
- PLASTIC INDEX
- DRY UNIT WEIGHT (LBS./CU FT)
- INTERNAL ANGLE OF FRICTION (DEGREES)
- COHESION (LBS./SQ IN)
- NATURAL SOIL MOISTURE CONTENT (PERCENT)
- MISCELLANEOUS



HKM ASSOCIATES
ENGINEERS-PLANNERS

Branch Offices:
• Bozeman, Montana
• Billings, Montana 59107
• Sheridan, Wyoming

Sheet No

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of 8

D13

NORTH FORK SMITH RIVER DAM
GEOTECHNICAL INVESTIGATION
LOGS OF EXPLORATION HOLES
ANGLED DRILL HOLES No. 121 & No. 122

Project No. 88027.137, ID No.

Date JULY 1989

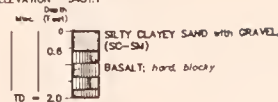
Designed

Drawn

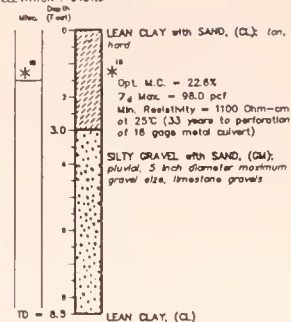
Checked

Approved

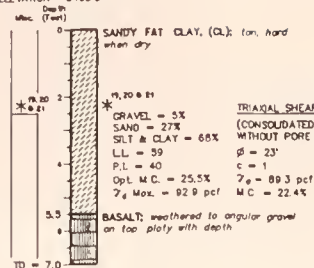
LOCATION 10250 S N, 0983.3 E
ELEVATION 5431.1



LOCATION : 10678.2 N, 8176.0 E
ELEVATION : 5451.5



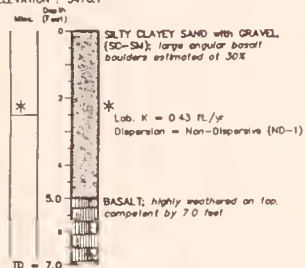
LOCATION : 11184.2 N, 8008.5 E
ELEVATION : 5480.0



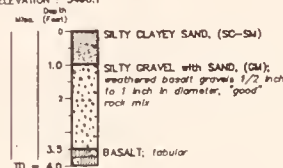
LOCATION 9124.3 N, 9116.4 E
ELEVATION 5488.0



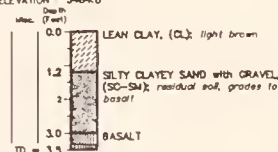
LOCATION : 9917.4 N, 9083.1 E
ELEVATION : 5470.1



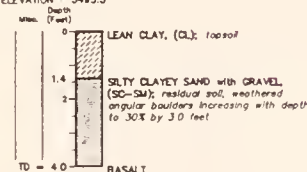
LOCATION : 11444.8 N, 9562.9 E
ELEVATION : 5408.1



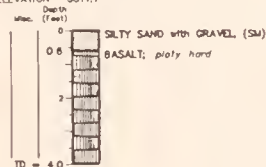
LOCATION : 11108.0 N, 9935.0 E
ELEVATION : 5484.0



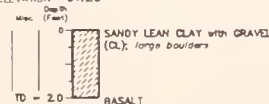
LOCATION 10902.0 N, 10142.1 E
ELEVATION 5495.3



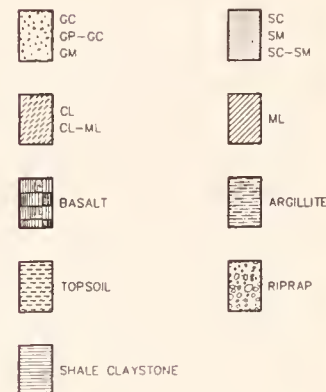
LOCATION 8860.4 N, 9397.0 E
ELEVATION 5511.7



LOCATION 9886.8 N. 9740.5 E
ELEVATION 5412.0



* *	INDICATES LOCATION OF SAMPLE ON WHICH LAB TESTS WERE MADE. RESULTS ARE INCLUDED IN TEXT OF LOC. THE NUMBER REFERS TO THE PLATE NUMBER IN THE APPENDIX ON WHICH ADDITIONAL INFORMATION IS PRESENTED
$\frac{1}{2}$	RECORDED GROUND WATER LEVEL (6-13-89)
TD	TOTAL DEPTH
N	NUMBER OF BLOWS REQUIRED TO DRIVE A STANDARD 2-INCH DIAMETER SPLIT SPOON PENETROMETER 12 INCHES INTO THE SOIL BY A 140-POUND HAMMER DROPPING FREELY A DISTANCE OF 30 INCHES
N'	STANDARD PENETRATION VALUE CORRECTED FOR EFFECTIVE OVERBURDEN STRESS AND SAMPLE DIAMETER
Rec.	RECOVERY (PERCENT)
RQD	ROCK QUALITY DESIGNATION (PERCENT) FROM CORE SAMPLES
K	FIELD PERMEABILITY IN FT./YR (U.S.B.R DESIGNATION E-18)
Compl	COMPLETION
L.L.	LIQUID LIMIT (PERCENT)
P.I.	PLASTIC INDEX
γ_d	DRY UNIT WEIGHT (LBS./CU FT)
ϕ	INTERNAL ANGLE OF FRICTION (DEGREES)
c	COHESION (LBS./SQ IN)
W.C.	NATURAL SOIL MOISTURE CONTENT (PERCENT)
Misc.	MISCELLANEOUS



44087-137 I O No Date JULY 1969
 NORTH FORK SMITH RIVER DAM
 GEOTECHNICAL INVESTIGATION
 LOGS OF EXPLORATION HOLES
 TEST PIT No. 201 thru TEST PIT No. 210

HKM ASSOCIATES
ENGINEERS-PLANNERS

Airport Industrial Park
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Billings, Montana 59107

Branch Offices:

- Bozeman, Montana
- Sheridan, Wyoming

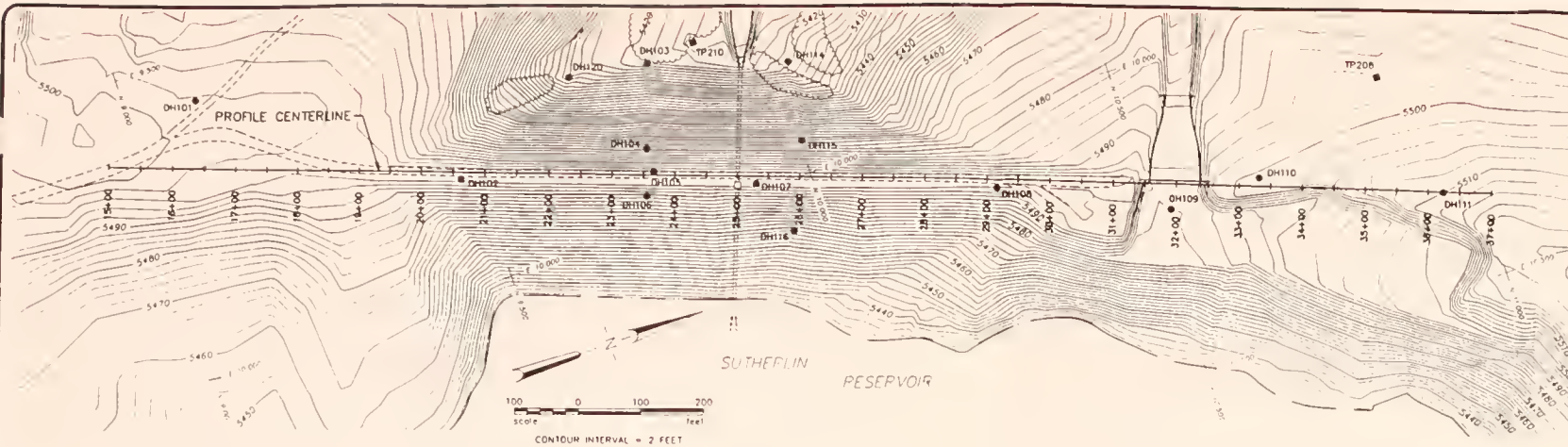
Project No. SM087.137 ID No. _____ Date JULY 1988 Designed _____ Drawn ML Checked _____ Approved _____

Project No.	59093-137	10 No.	Date	JULY 1969	Designed	Drawn/Checked	Approved
NORTH FORK SMITH RIVER DAM							
GEOTECHNICAL INVESTIGATION							
LOGS OF EXPLORATION HOLES							
TEST PIT No. 201 thru TEST PIT No. 210							
No.	Revision		By	Date			
1	LOCATION RECHECKED			9/8/92			
2	REWORKED FOR 1969			9/8/92			

Sheet No. _____

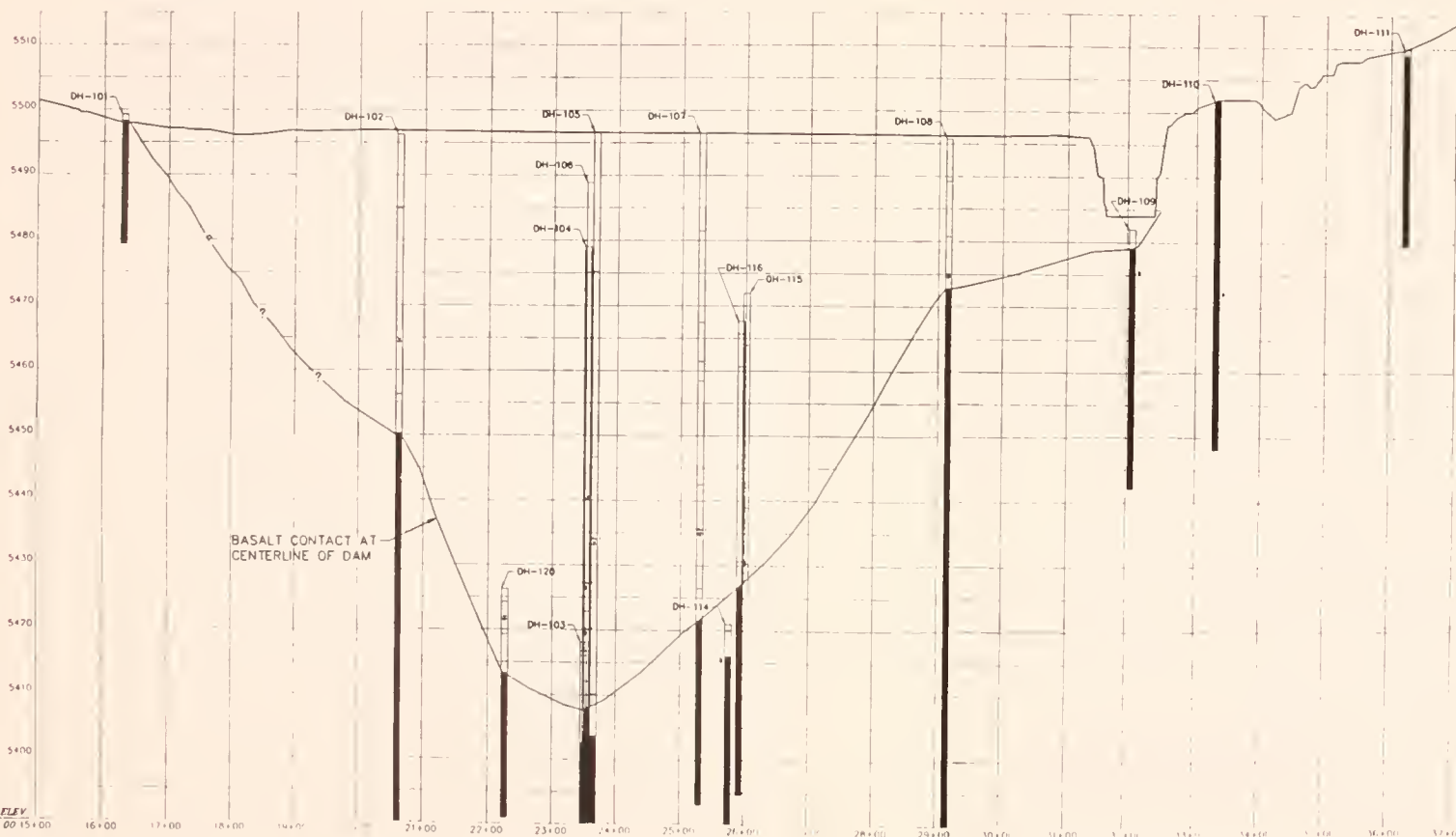
7

1. 8



LEGEND OF EXISTING FEATURES

- COORDINATE GRID TICK
- GROUND SURFACE CONTOURS
- EDGE OF ROAD OR TRAIL
- EDGE OF WATER
- TREES OR BUSHES
- CONCRETE STRUCTURES
- DRILL HOLE LOCATION
- TEST PIT LOCATION



D17

H&M ASSOCIATES
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Branch Offices:
• Sheridan, Wyoming
• Miles City, Montana

NORTH FORK SMITH RIVER DAM REHABILITATION
MEAGHER COUNTY, MONTANA

GEOTECHNICAL INVESTIGATION
EXISTING DAM PLAN AND PROFILE

Project No. AUG87-133 • Client: DNR • Designer: H&M • Date: DEC. 1993 • Preparer: CC • Drawn: GLE • Checked: ZCO • Enclosure: 1

No.	Revision	By	Date
0	WARNING		
1	IF THIS SHEET DOES NOT HAVE A DATE, IT IS NOT TO SCALE		

Sheet No.

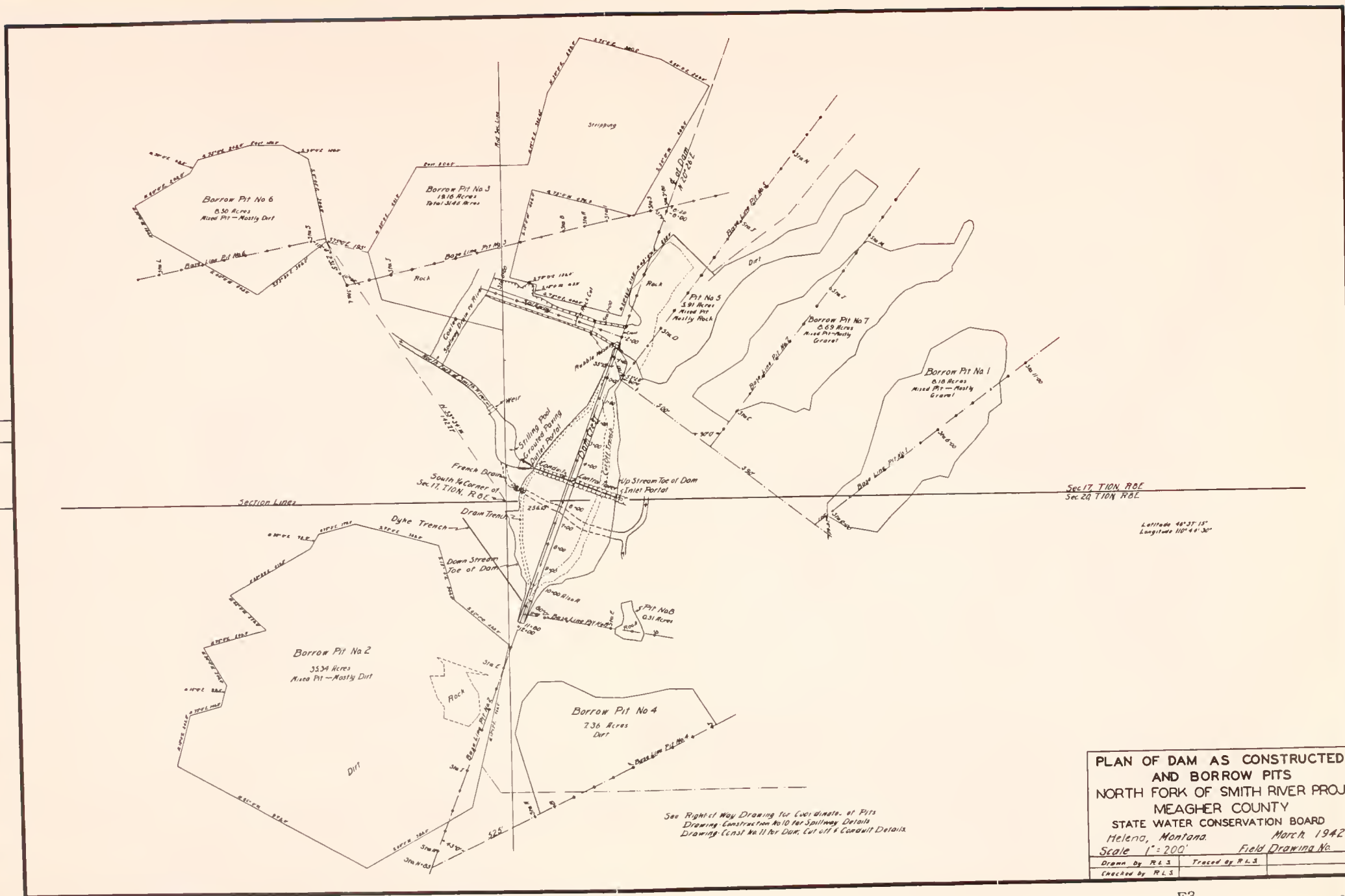
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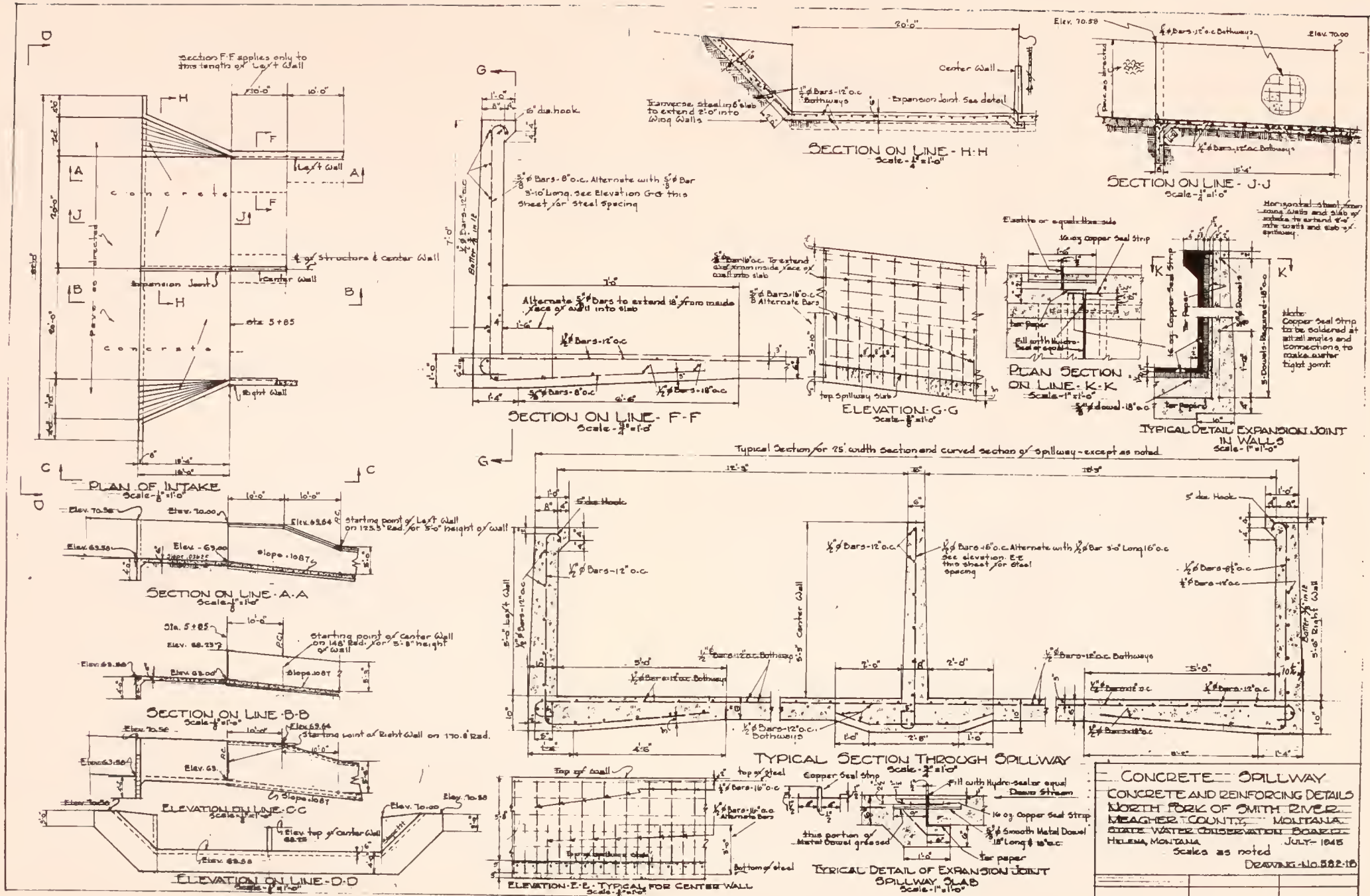
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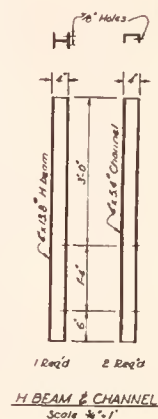
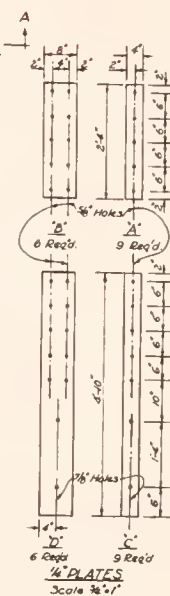
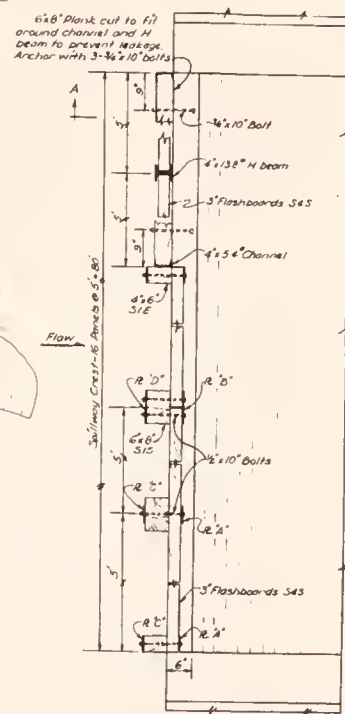
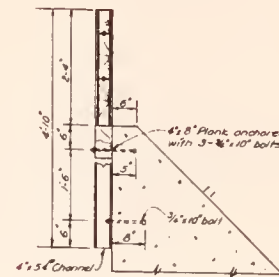
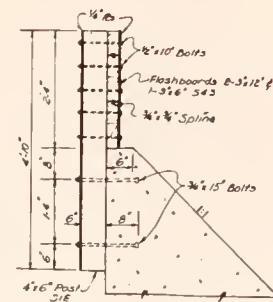
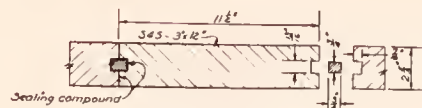
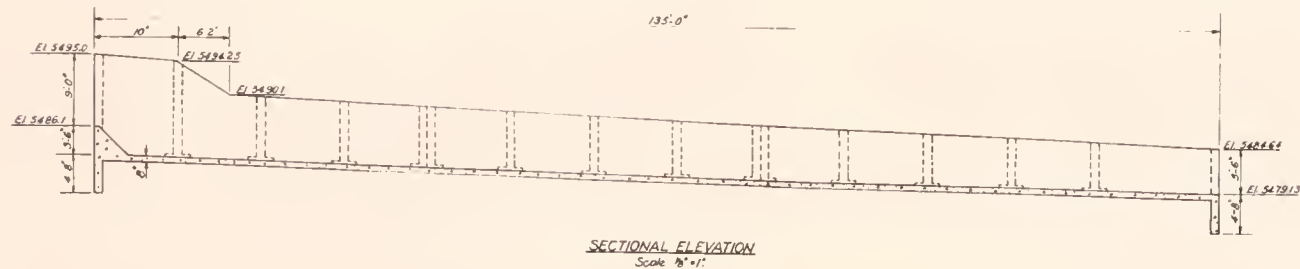
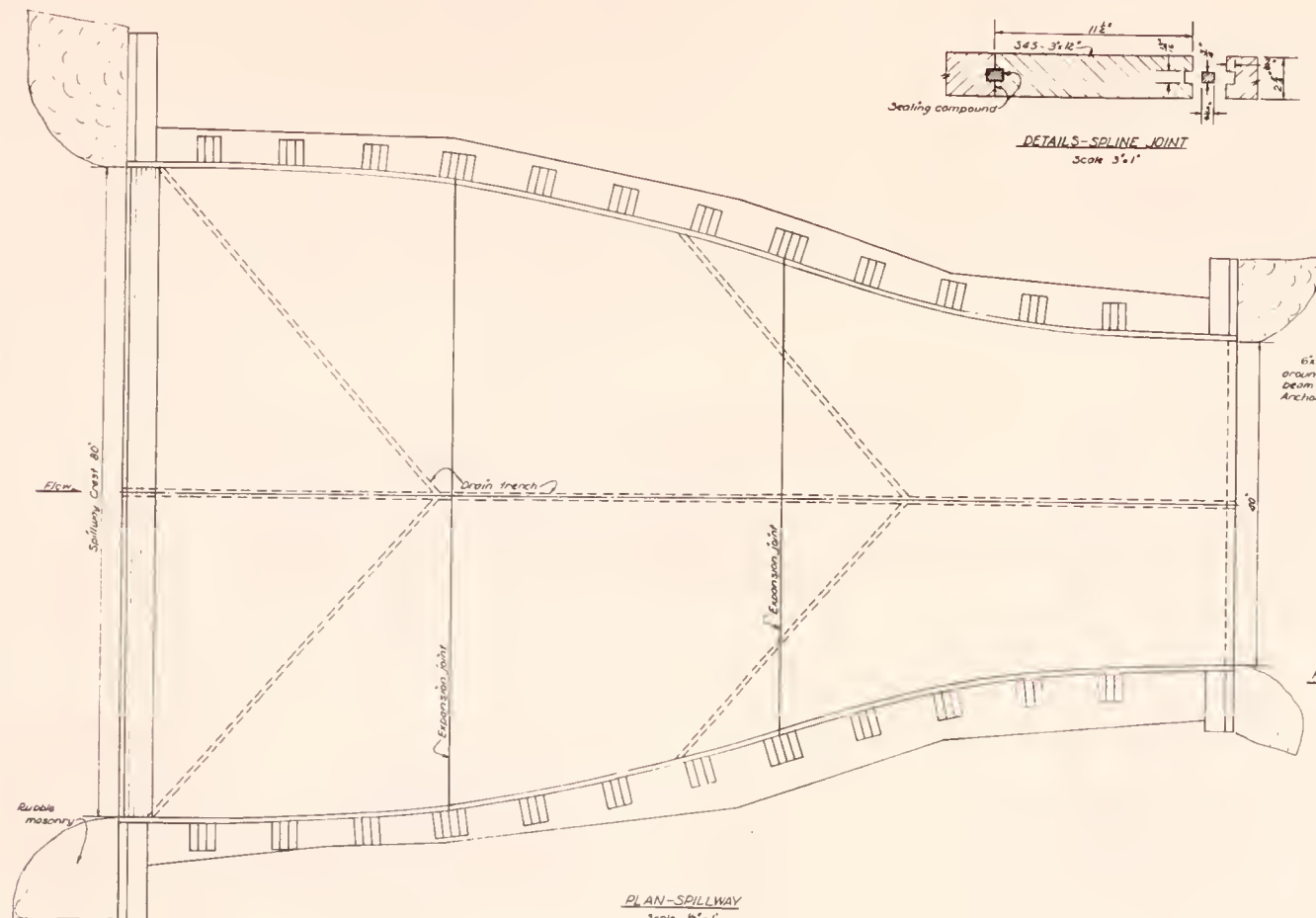
APPENDIX E

PROJECT DRAWINGS

(NOTE: These reduced project drawings are design drawings and not "As Built". These drawing should be used for reference only. The SWPB has the full size project drawings.)







GENERAL NOTES:
Spillway dimensions taken from
Drawg. No Const 10.
Drill $1\frac{1}{2}$ " holes in spillway crest
for anchor bolts and grout in place.
Use anchor bolts with hexagon
heads.

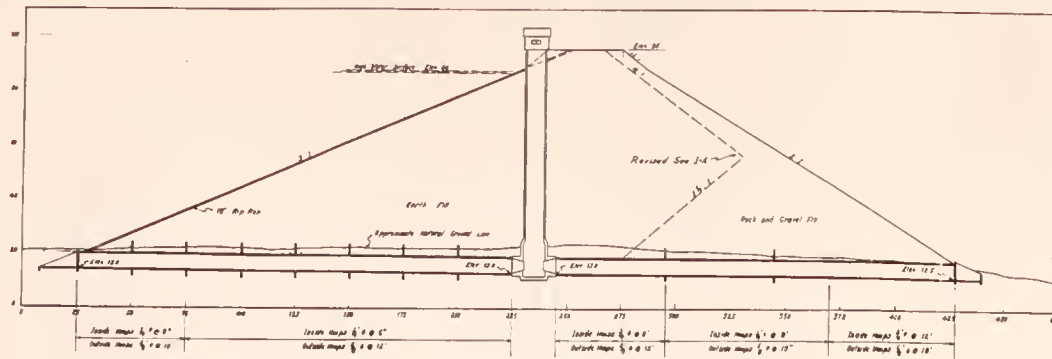
DETAILS-SPILLWAY FLASHBOARDS
NORTH FORK SMITH RIVER STORAGE PROJECT
MEAGHER COUNTY

STATE WATER CONSERVATION BOARD
HELENA, MONTANA
APRIL 1948
SCALE AS SHOWN

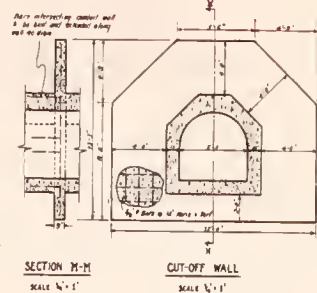
Drawn by SPW

E11

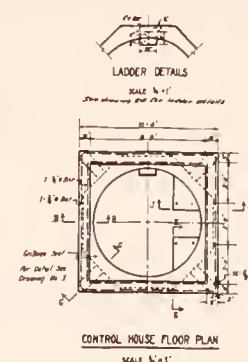
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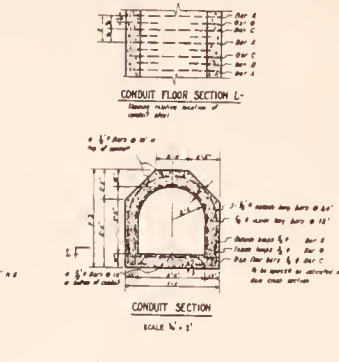
DAM SECTION THROUGH CONDUIT
SCALE 1/4" = 1'-0"



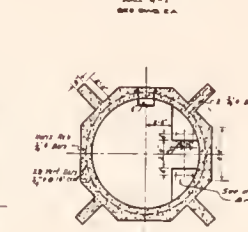
SECTION M-M
SCALE 1/4" = 1'-0"



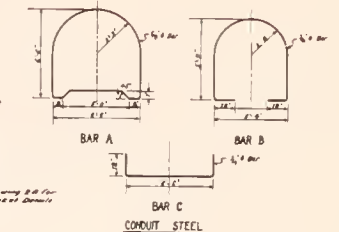
CONTROL HOUSE FLOOR PLAN
SCALE 1/4" = 1'-0"



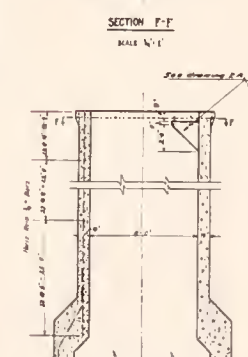
CONDUIT FLOOR SECTION L-L
SCALE 1/4" = 1'-0"



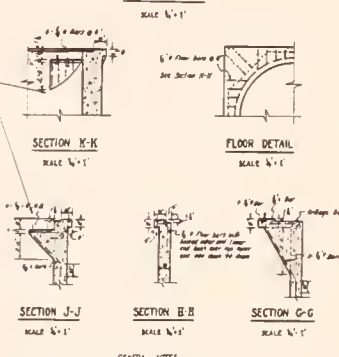
SECTION P-P
SCALE 1/4" = 1'-0"



CONDUIT SECTION
SCALE 1/4" = 1'-0"



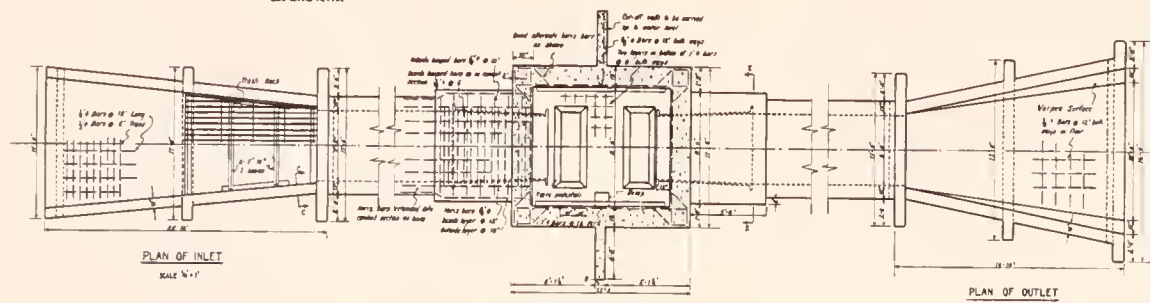
CONTROL TOWER SECTIONAL ELEVATION
SCALE 1/4" = 1'-0"



CONDUIT STEEL
SCALE 1/4" = 1'-0"



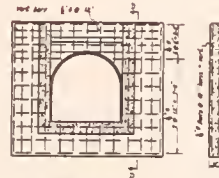
SECTION C-C
SCALE 1/4" = 1'-0"



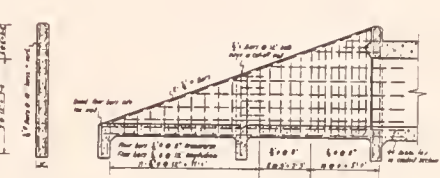
PLAN OF INLET
SCALE 1/4" = 1'-0"

CONTROL CHAMBER SECTION A-A
SCALE 1/4" = 1'-0"

PLAN OF OUTLET
SCALE 1/4" = 1'-0"

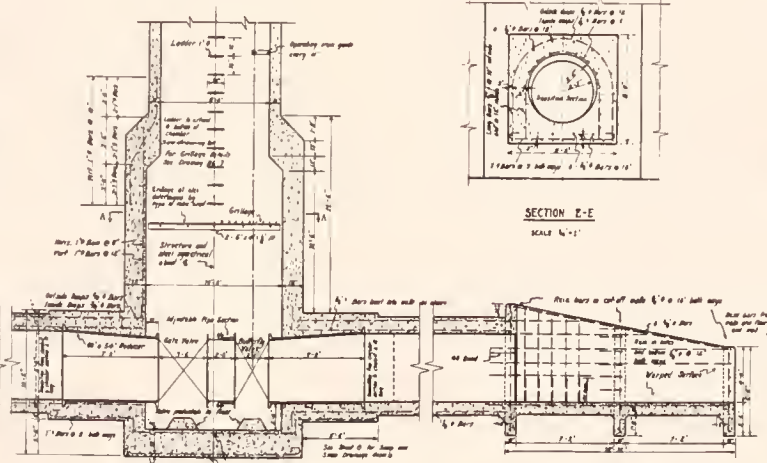


HEADWALL AT B-B
SCALE 1/4" = 1'-0"

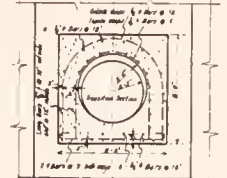


SECTION D-D
SCALE 1/4" = 1'-0"

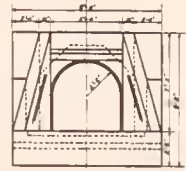
SECTIONAL ELEVATION OF INLET
SCALE 1/4" = 1'-0"



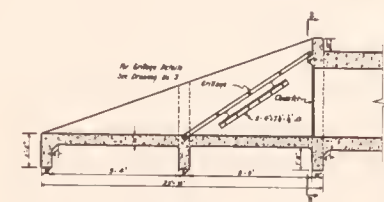
SECTIONAL ELEVATION OF CONTROL CHAMBER
SCALE 1/4" = 1'-0"



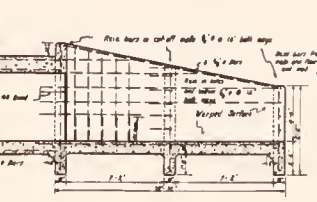
SECTION E-E
SCALE 1/4" = 1'-0"



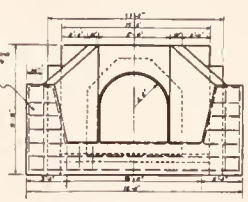
END ELEVATION OF INLET
SCALE 1/4" = 1'-0"



SECTIONAL ELEVATION OF INLET
SCALE 1/4" = 1'-0"



SECTIONAL ELEVATION OF OUTLET
SCALE 1/4" = 1'-0"



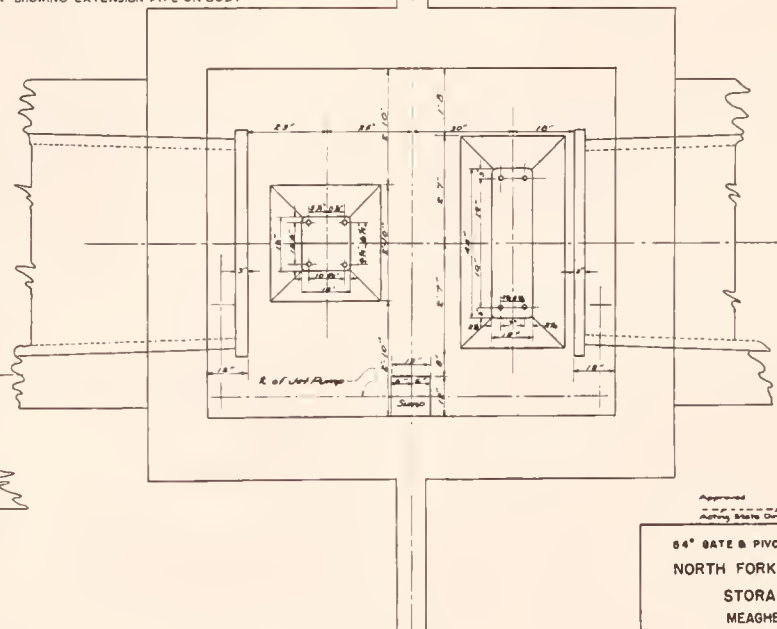
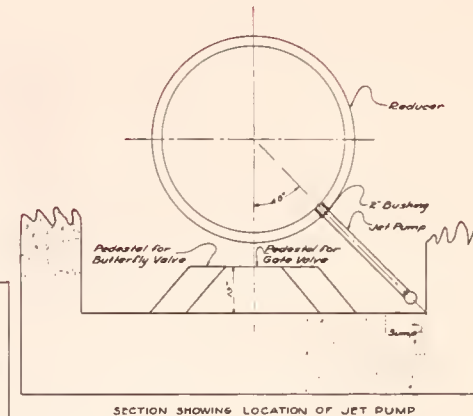
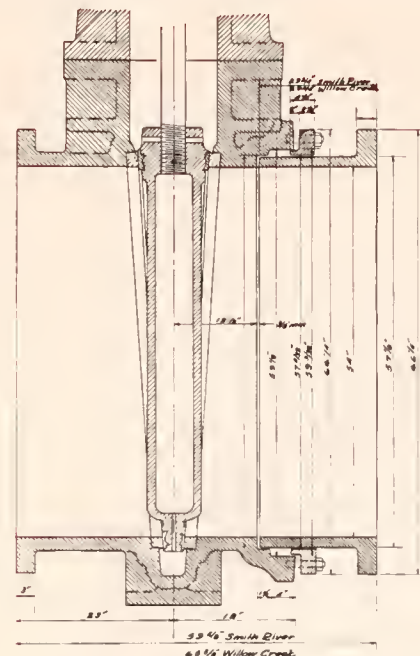
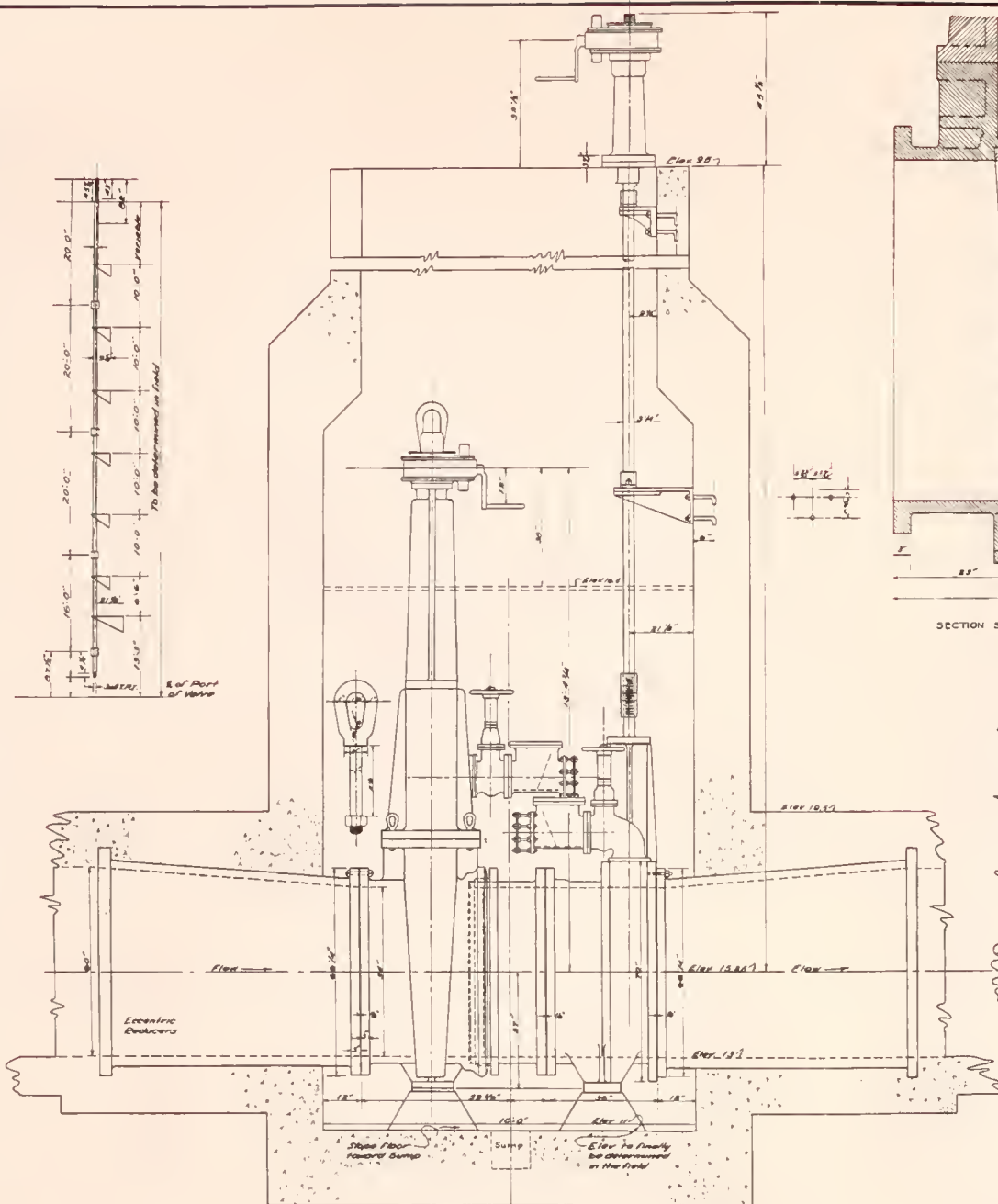
END ELEVATION OF OUTLET
SCALE 1/4" = 1'-0"

GENERAL NOTES
1. All materials unless otherwise specified shall be of the best quality obtainable.
2. Reinforcing steel shall be of the best quality obtainable.
3. All dimensions shall be in feet and inches.
4. All dimensions shall be in feet and inches.
5. All dimensions shall be in feet and inches.

For Revision 3 use
Dwg. N.P.A.
Dwg. N.P.A.

CONTROLLING WORKS
NORTH FORK SMITH RIVER STORAGE
PROJECT
MEAGHER COUNTY
MONTANA WATER CONSERVATION BOARD
SCALE - AS SHOWN
P.W.A. NO. 1008
DRAWING NO. 2

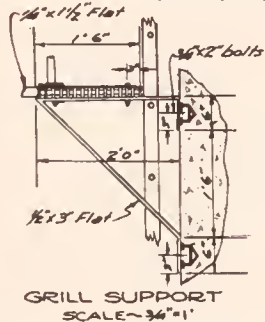
APPROVED
SPECIAL ENGINEER



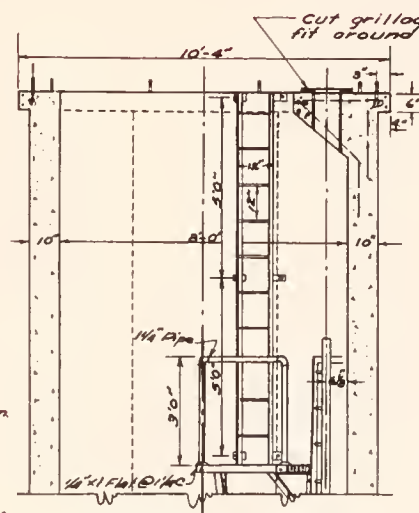
Approved _____
 Acting State Engineer P.W.A. Montana

54" GATE & PIVOT VALVE WITH REDUCERS
 NORTH FORK OF SMITH RIVER
 STORAGE PROJECT
 MEAGHER COUNTY
 STATE WATER CONSERVATION BOARD
 HELENA MONTANA APRIL 1936
 PWA NO. 1008 SCALE AS SHOWN DRAWING NO. 27-21-2

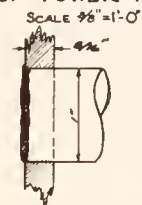
PLAN OF GATEHOUSE FOUNDATION



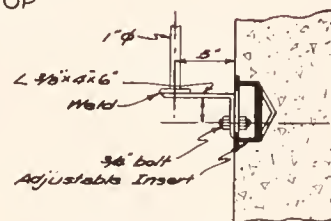
Note: Grillage to set
down inside pilla.



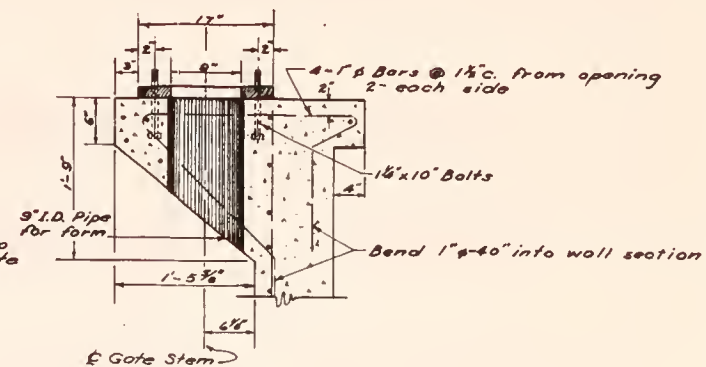
SECTIONAL ELEVATION
OF TOWER TOP



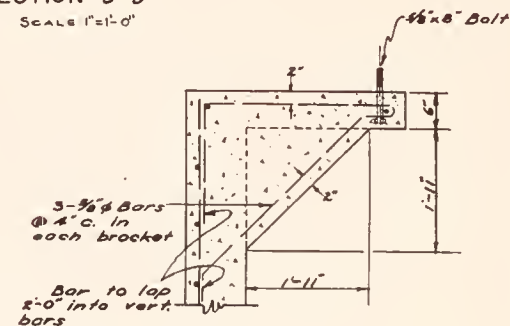
12 LUNG CONNECTION
DETAILS
SCALE ~ 1" = 1"



DETAIL OF LADDER
CONNECTION TO WALL
SCALE ~ 1 1/2" = 1'



SECTION B-B
SCALE 1"=1'-0"

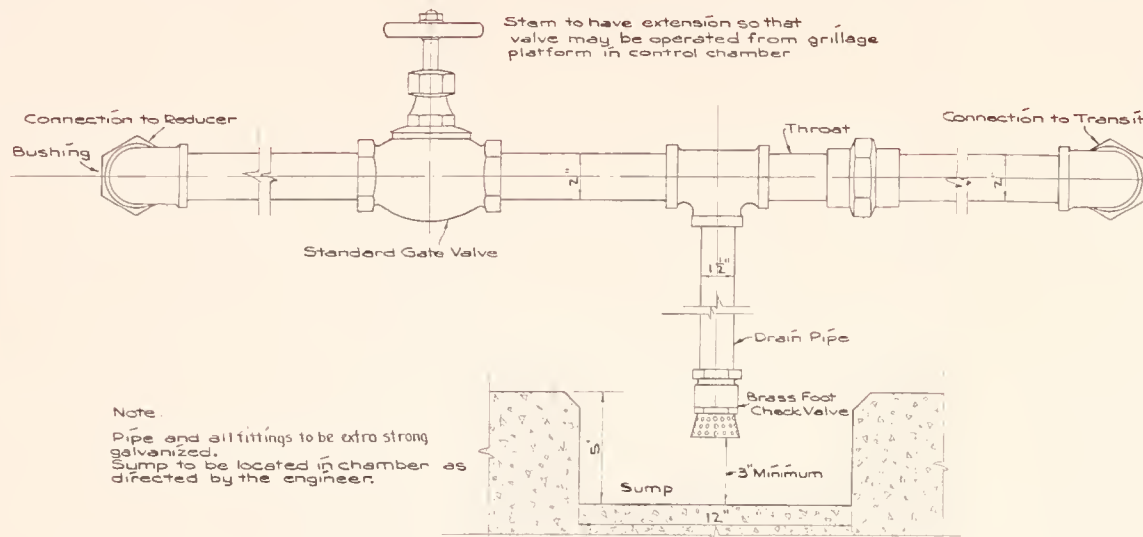


SECTION C-C
SCALE 3/4" = 1'-0"

REVISED OUTLET WORKS DETAILS
NORTH FORK SMITH RIVER STORAGE PROJECT
MEAGHER COUNTY
MONTANA WATER CONSERVATION BOARD
SCALE AS SHOWN MARCH 2, 1936
P.W.A. NO. 1008. DRAWING NO. 2A

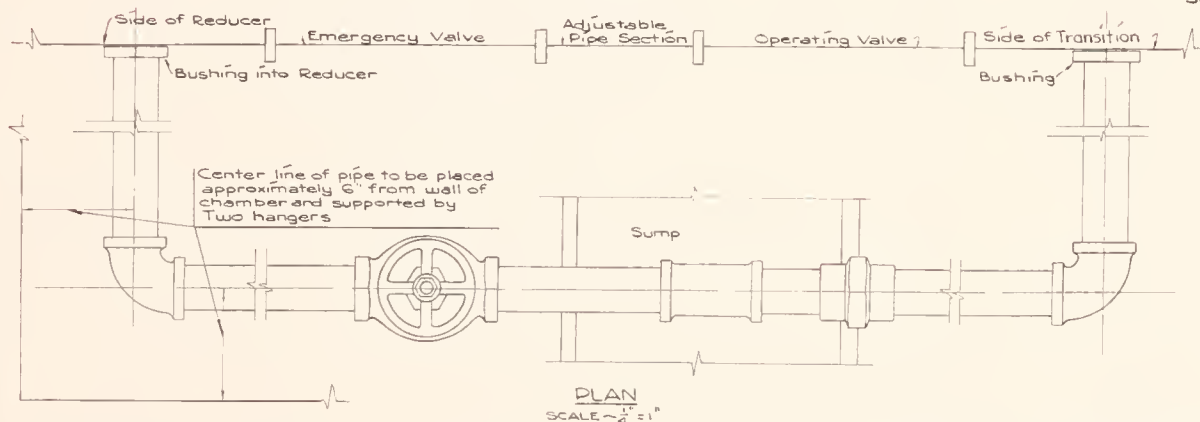
Approved	
Acting State Director PWA Montana	

45-82-7

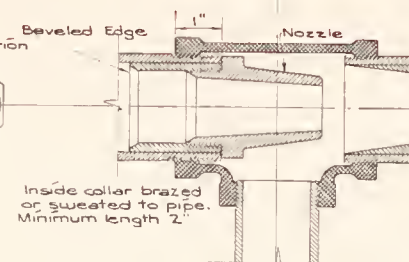


Note:
Pipe and all fittings to be extra strong
galvanized.
Sump to be located in chamber as
directed by the engineer.

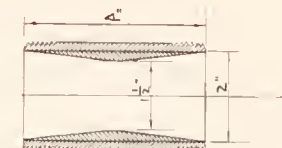
ELEVATION
SCALE $\sim \frac{1}{4}'' = 1''$



PLAN
SCALE $\sim \frac{1}{4}'' = 1''$

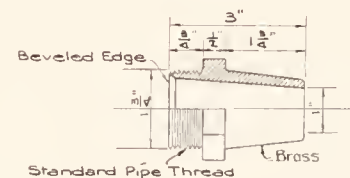


SECTION THROUGH TEE
SCALE $\sim \frac{1}{2}'' = 1''$

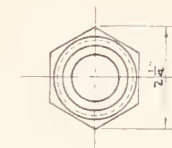


Throat to be made by filling
with brazing metal

SECTION THROUGH THROAT
SCALE $\sim \frac{1}{2}'' = 1''$



NOZZLE DETAIL
SCALE $\sim \frac{1}{2}'' = 1''$



STANDARD JET PUMP

FOR SUMP DRAINAGE

STATE WATER CONSERVATION BOARD

HELENA, MONTANA

OCT. 31, 1935

SCALE AS SHOWN

DWG. S-10

Drawn by	WVJ	Checked by	GFS		
Traced by	JCK				

